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PINYON-JUNIPER

CHAINING

ENVIRONMENTAL IMPACT STATEMENT

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U.S. Department of the Interior
Bureau of Land Management

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Pinyon-Juniper Chaining Environmental Impact Statement

BACKGROUND

A. A proposal to manipulate pinyon-juniper stands on a specific land area evolves from a comprehensive framework planning process identified as a management framework plan (MFP). Prior inventory and opportunity evaluation studies (URA) identify land areas that have technical and economic feasibility for vegetation manipulation to improve watershed condition and/or increase forage production.

Considering the capability and opportunity for pinyon-juniper manipulation, the projected need for outputs resulting from this action and the current BLM policy relating to the activity, unconditioned proposals were made by a resource specialist.

Proposals from the eight standard BLM resource programs are then compared by managers to identify complimentary and conflicting proposals.

Applying all available technical, economic, social and political information, resource managers analyze the proposals and formulate a coordinated framework plan that will determine management objectives and guide future BLM actions. Specific resource activity plans in a geographic area are guided and constrained by the MFP.

B. Within the constraints of the MFP, specialized planning is advanced on a logical watershed area. Specialized watershed planning has the objective of protecting each watershed from further deterioration with conservation practices and development projects which have

benefits exceeding costs.

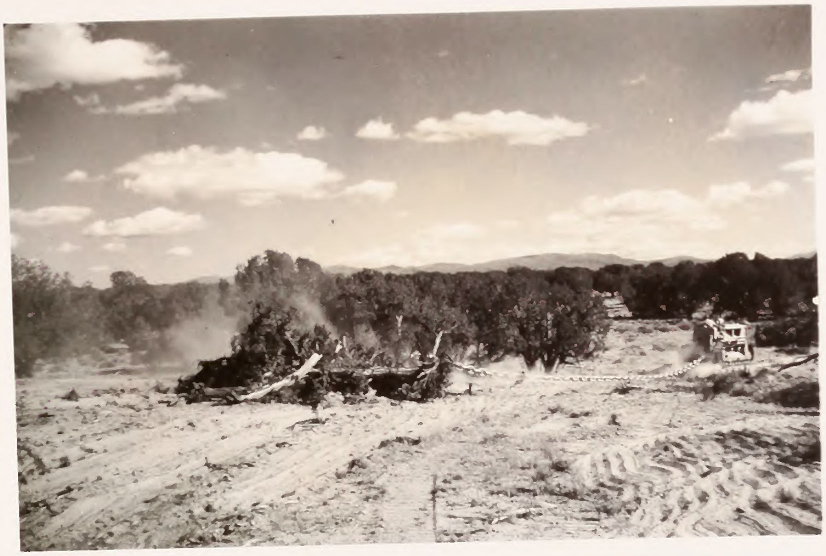
Watershed management objectives with identified primary opportunities for actions are considered in a systematic process involving detailed inventory analysis of proposals from a technical, environmental, social and economic standpoint, identification and analysis of alternatives, and finally recommended actions. Any recommendations for actions would require coordination with other resource activities and consideration of the National Environmental Policy Act requirements before such actions would be included in the annual operating budget.

C. Wildlife habitat management objectives identified in the management framework planning process outlined in "A" above, are planned in detail through a habitat management plan. Habitat development or improvement such as pinyon-juniper chaining and establishment of desirable plant species receive consideration as a management method. Proposals are coordinated with interested state and federal agencies and other resource activities before projects are proposed for inclusion in the annual operating budget. Requirements of the National Environmental Policy Act are also applied to such actions.

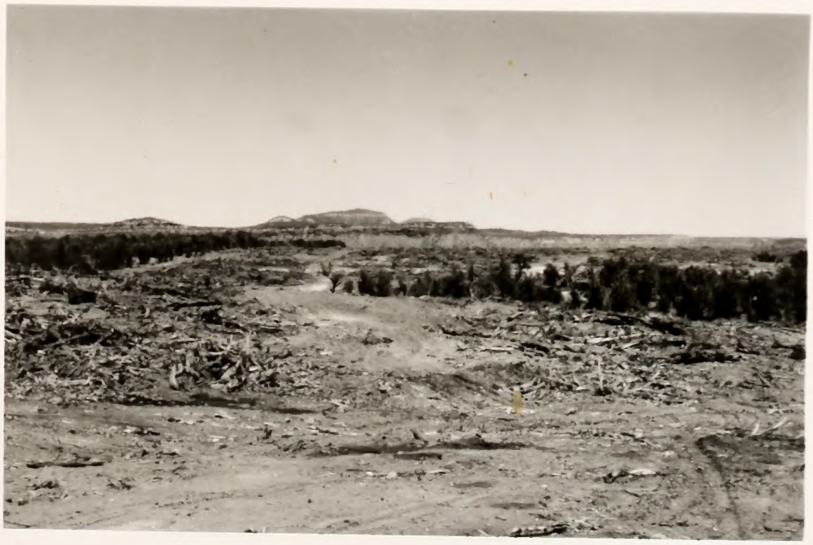
D. Needs for livestock forage are identified in the management framework planning process. Primary opportunities for increasing livestock forage are then identified and may include pinyon-juniper conversion.

These needs and opportunities are considered when developing an allotment management plan which includes an intensive grazing management system for a limited area of operation. Resource

experts develop these plans after evaluating alternatives for increasing forage production through grazing systems, land treatment and installation of stock facilitating projects. In cases where land treatment is needed to meet specific objectives and where it is the most economical alternative, specific projects are proposed. After concurrence by affected livestock operators, coordination with other resource programs and fulfillment of requirements under the National Environmental Policy Act, such projects are proposed for inclusion in the annual operating budget.



Chaining Operation in progress



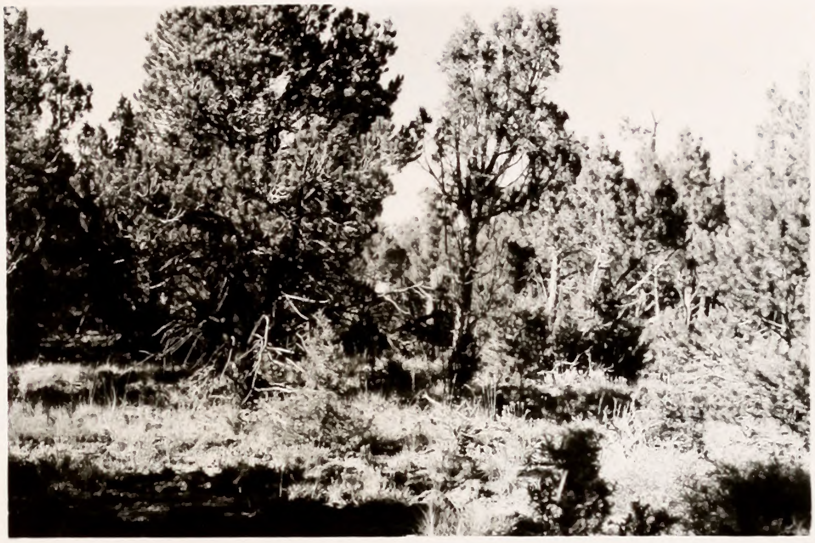
Chained area immediately after double chaining, debris in place treatment

I. Description of the Proposal

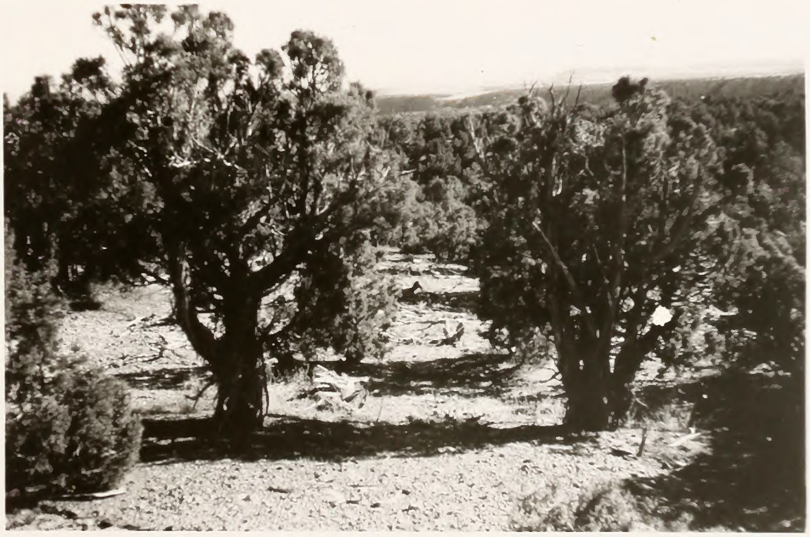
Conversion of vegetation on pinyon-juniper areas through chaining. For the purpose of definition, this proposed action is described as: Dragging a 90 lb. per link anchor chain between two crawler type tractors through an area where a major portion of the vegetative cover consists of either pinyon pine and/or juniper. This chaining will consist of two passes in opposite directions. As the chain is dragged through the stand, trees are broken and uprooted, causing considerable soil disturbance. Soil is disturbed and compacted by the crawler treads on each of the tractors. The debris from this operation is left in place on the ground.

The purpose of the proposed action is the conversion of pinyon-juniper dominated vegetative type to a shrub or grass type for one or more of the following reasons: (1) Increasing livestock forage. (2) Increasing or changing wildlife habitat. (3) Improving watershed capability. (4) Changing the visual environment.

The proposed action is to take place on Bureau of Land Management (BLM) managed lands on sites identified through the BLM land use planning system as suitable and desirable for this type of action.



Pinyon-Juniper stand with vigorous understory of grass and shrubs



Pinyon-Juniper stand with little understory vegetation

II. Description of the Environment

A. Non-living components

1. Land

a. Soils

The parent materials from which most pinyon-juniper soils were developed are residum, colluvium, and alluvium of sedimentary rock origin. In areas where volcanic and limestone rocks provide the parent materials, soils are less erodible than are those of shale and sandstone origin.

The pinyon and junipers grow well on rocky, gravelly slopes on residual, unweathered or recently weathered material, and on shallow and porous soils. The deeper alluvial soils of the valley bottoms are usually occupied by sagebrush or other shrubs and herbaceous vegetation.

Soil depth (depth to which plant roots generally penetrate) is highly variable in the pinyon-juniper type. On some of the steeper and rougher areas, the soils may be very shallow or negligible with much exposed bedrock, while on other slopes a more adequate soil may have formed. In areas of 15% or less slope, deeper soils have developed, although seldom over four feet in depth. The soil forming processes are limited due to ~~low~~ cold winter and spring temperatures and low precipitation. In most of the pinyon-juniper type areas, the soluble salts are leached to the one to two foot level.

The lower limits of the pinyon-juniper type are ~~limited~~ Controlled by deficient soil moisture and finer textured soils. Soil moisture

availability is the major factor controlling plant community patterns in this pinyon-juniper zone. Moisture availability depends upon amount and seasonal distribution of precipitation and upon the physical properties of the soil.

The length of time during which plants are subject to high soil moisture is less on coarse textured than on fine textured soils. In dry climates, coarse soils support plants with higher moisture requirements than do the finer ones. (The reverse may be true where precipitation reaches 30" to 35" or more.) Thus the pinyon-juniper type is found on the coarser, rockier sites and herbaceous vegetation on the finer soils. The most consistent indicator of a pinyon-juniper adapted site is stoniness or coarseness of soils which provides rapid infiltration, deep penetration and low soil moisture tension.

omit

Soils commonly found in the P-J type are classified, under the new Soil Taxonomy Classification System of the Soil Conservation Service, as Entisols, Aridsols, Mollisols, and Vertisols. Vertisols are common only to the southern part of the P-J type and the other orders occur generally throughout the type.

b. Chemical Soil Pollution: define

what are they

Pinyon-juniper stands have been shown to have at least two chemical phenomena which affect the soils under the trees growing in an undisturbed nature. It has been shown by some research workers (Jameson 1961-Jameson 1968) that both pinyon and juniper produce a growth or germination inhibitor which affect the vegetation growing directly under the trees. These inhibitors seem to affect

particularly the cool season species. Whether this material moves or not is not known and the full impact of this material on other components of the environment is not known.

? (where does this come from) what research

The second chemical, which could be the same, produces non-wettability of soils in some areas. This is believed to be associated with the decomposing litter directly under the trees. The extent of movement and/or damage of this material is not known either.

The exact circumstances required for these materials to be produced is not completely understood. This makes it impossible to say whether they exist in only certain areas or if they exist under each tree to some degree.

2. Water

In general the waters produced from crossing stands of pinyon-juniper ~~stands~~ are ~~floodwaters heavily laden with silt and~~ are the result of torrential thunderstorms which produce damaging floodwaters and overland flows heavily laden with silt rather than beneficial flows. The possibility of producing gentle beneficial flows during thunderstorms, or producing additional water from these watersheds for downstream irrigation or recreation seem to be questionable. There is an experimental watershed in Arizona studying the possibility of increasing usable water from pinyon-juniper type watersheds. This study, after 13 years of pre and post treatment data, have found that clearing of pinyon-juniper on 38% of the treatment watershed resulted in neither an increase or decrease in water yield.

Since this ecosystem is climatically associated with a semi-arid climate having an annual precipitation between 8 and 18 inches per

year, the actual water production per acre is probably insignificant. Dortignac (1956) has shown for the Rio Grande Basin above Elephant Butte Reservoir, the pinyon-juniper average annual water yield is 0.1 to 0.5 inch.

a. Water Quality

Water quality as related to pinyon juniper watersheds is basically unknown. However, review of the Utah State Engineer's technical publication #10 concerning chemical quality data of surface waters in Utah indicates that watersheds associated with pinyon juniper ecosystems have a ph between 7.3 and 8.1 and are characterized by as much as 2600 parts per million of dissolved solids. Generally, waters having these characteristics would require treatment for culinary or industrial uses.

3. Air

The Southwest Energy Study considers the air quality in this general area as pristine and clear. However, air pollution is evident in the highly populated areas such as Salt Lake and Las Vegas.

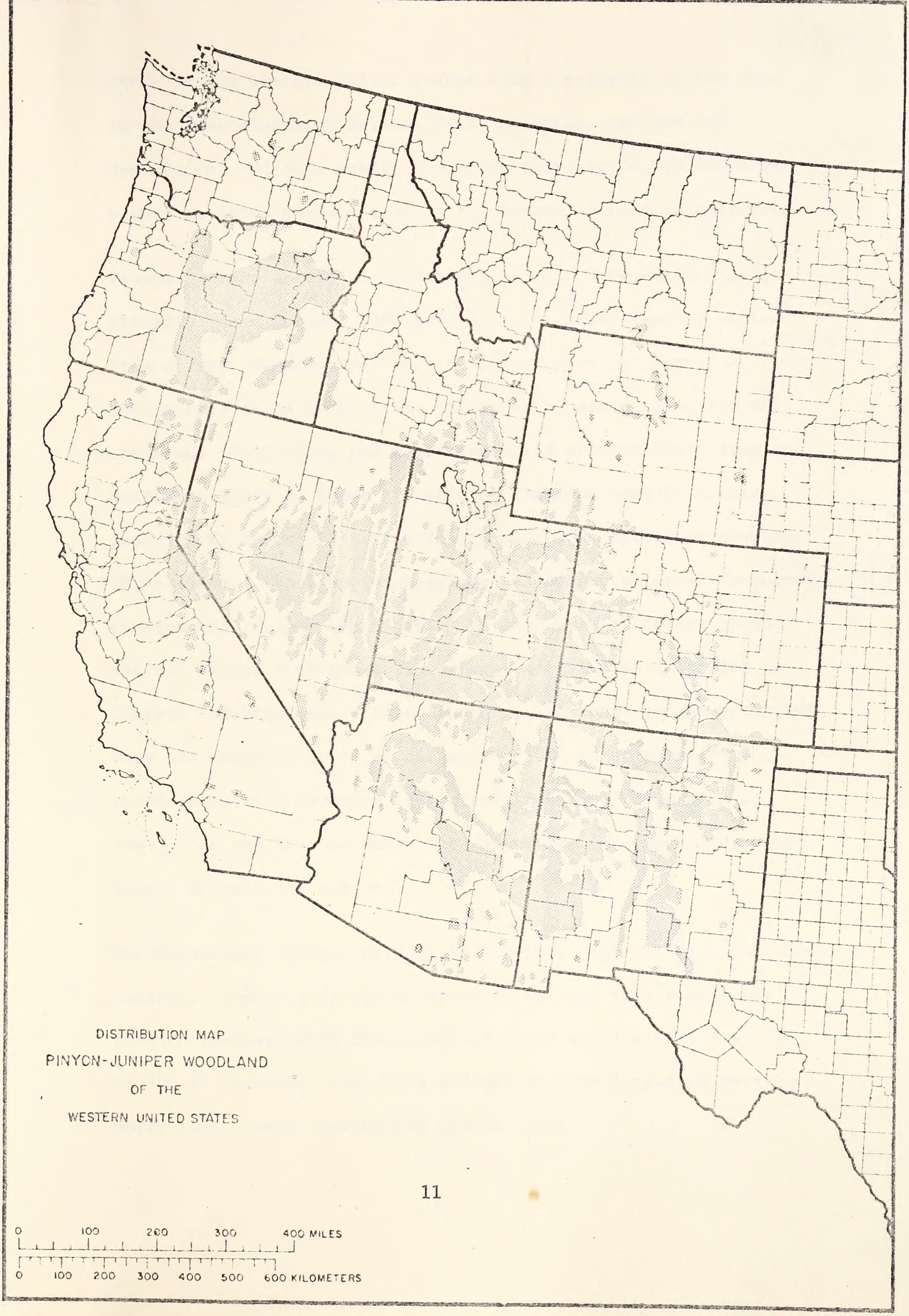
Also, "emissions from the coal burned at the Four Corners Electric Generating Plant in New Mexico has been a conspicuous contributor to air pollution in that portion of the basin", i.e. Four Corners Area.

Wind velocities in this portion of the southwest vary and gusts of 50 MPH are considered common.

B. Living Components

1. Vegetation

The pinyon-juniper type covers an area of approximately 60,000,000



DISTRIBUTION MAP
PINYON-JUNIPER WOODLAND
OF THE
WESTERN UNITED STATES

acres in the western United States with a majority of the type in the five states of Nevada, Utah, Colorado, Arizona and New Mexico. Of this total, about one third or 20,000,000 acres occurs on lands administered by the Bureau of Land Management.

Pinyon juniper occurs at elevations between 5,000-7,000 feet, (locally found between 3200-9000'). Stand density varies from a very few trees per acre to 600 or more per acre. A rather open stand is typical, but areas of dense trees are not uncommon. Very often the stand increases progressively from the scattered trees at lower elevations. Maximum density occurs just before the rapid transition is made into timber or mountain shrub types. The lower, sparse part of such type areas frequently consists of juniper reproduction on sagebrush or desert grass sites. Pinyon pine generally becomes established following juniper establishment. Since junipers are more drought resistant they are commonly found at elevations 500' lower than pinyon. Broad areas with savannah characteristics occur primarily in New Mexico and Arizona where the understory is composed of mixed desert grasses and shrubs.

what causes encroachment

The herbaceous undercover varies inversely with the tree and shrub density. However, it was observed in Arizona that shrubs may tend to increase with the number of trees until a tree density of 50% is reached. The shrub undercover then decrease~~d~~s sharply where tree canopy exceeds 60% ground cover.

Plant production under natural conditions is greatest in the southern portion (Arizona and New Mexico) of the P-J type. This is true of both trees and understory. Trees will grow to 40 feet on the better sites in the south, while 30 feet is about maximum in the northern areas.

Plant composition of P-J woodland is highly varied, as may be expected from the great differences in site characteristics over the extent of its range. The most important tree components are Utah juniper (*Juniperus osteosperma*), one seed juniper (*J. monosperma*), and pinyon (*Pinus edulis*). Other trees of prominence are singleleaf pinyon (*P. monophylla*), alligator juniper (*J. deppeana*), and, to a limited extent, Rocky Mountain juniper (*J. scopulorum*). Trees of little importance and local significance only are Mexican pinyon (*P. cembroides*) and California juniper (*J. californica*).

Utah juniper dominates the type in Nevada, Utah, Western Colorado, and Northwestern Arizona. To the southeast in Arizona and New Mexico it tends to be gradually replaced by oneseed juniper which becomes dominant. Alligator juniper is most prominent in southwestern New Mexico and East Central Arizona, but occurs more sparingly through a large portion of these two states at higher elevations. Throughout most of the P-J type range and beyond to the north, Rocky Mountain juniper may be found, usually at higher altitudes. It is a major tree component in some areas east of the Continental Divide and north of New Mexico.

Pinyon is the main pine constituent through most of the type. It occurs in mixture with the various junipers, usually as scattered trees but often as a codominant. Occasionally it is the dominant conifer at higher elevations. In Nevada, California, and some parts of Southwestern Utah and Northwestern Arizona, pinyon is replaced by singleleaf pinyon where it grows principally with Utah juniper and sometimes in nearly pure stands. The Mexican pinyon is a woodland component only in southwestern New Mexico, Southeastern Arizona, and on southward.

The flora of different physiographic areas of the P-J type are conditioned by climatic and other factors encountered. Prominent plant species and associations vary accordingly.

Mature pinyon and juniper trees are exceptionally long lived. Aging studies done in Northern Arizona show pinyon to be 357 years old with juniper reaching 467 years of age.

2. Animals

The pinyon-juniper type, with its myriad variations and combinations of vegetal components, topography, altitudes, precipitation and soils supports a correspondingly variable faunal complex (Table 1). This faunal component exhibits a remarkable diversification in its adaptation to, and dependency on, the pinyon-juniper zone. The animals of the pinyon-juniper do not occur there merely by chance but constitute groups of individuals with more or less similar gene combinations optimally adapted for the supplied environment. This environment forms the "ecological niche" in which the individual species fits and where it is superior to its competitors (Mayr, 1949). The efficiency with which the species occupies a

"niche" often depends on its behavioral and physiological response and toleration to that portion of the environment. Particularly in the pinyon-juniper zone, there is considerable variance among species in tolerating environmental differences. This toleration is often of extreme importance in limiting the range and preventing the animal from expanding into areas to which it is not adapted (Woodbury, 1954).

Most of the more common animal~~s~~ association with the pinyon-juniper complex are eurytopic and utilize the variety of environmental conditions confronting them with considerable flexibility. It is with these animals that the vegetational zones adjacent to the pinyon-juniper exert their most obvious influence. This influence is so great that it creates a somewhat indistinct definition of which animals are, or are not, typical of the pinyon-juniper association. Some species, such as the coyote, are certainly typical of the pinyon juniper but are also normal members of virtually all other life zones. Some animal use may be heavy but seasonally oriented as with wintering deer. Still other animals, particularly some avian species, frequent the P-J zone only incidentally to their migrations. Few animals are intrinsically bound to the pinyon-juniper type, though many are considered typical of it. There is information, however, which indicates that some species tend to be stenotopic and are at least partially limited to environments which generally correspond to some regions of the pinyon-juniper zone. Some animals, such as kangaroo rats (*Dipdodomys* sp.) with their stringent water

economy and nocturnally adaptive enlargement of the middle ear (Webster, 1965), exhibit physiological modifications which tend to confine them to restricted environments typical of portions of the pinyon juniper association. Many reptiles and invertebrates also show similar adaptations. Dietary preferences of some species may also issue some apparent habitat constraints. The winter diet of the white-headed woodpecker (*Dendrocopus albolarvatus*) is estimated to be made up of 71% pinyon pine seeds. A very large proportion of the pinyon jay's (*Gymnorhinus cyanocephalus*) diet is also pinyon seed (Martin, et.al., 1951). Utah juniper berries were found to be the single most important plant food in the diet of both deer mice (*Peromyscus maniculatus rufinus*) and pinyon mice (*Peromyscus truei truei*) in a Colorado study (Shepard, 1972).

There is a variety of animals which are found within the pinyon juniper only by virtue of the presence of a specific habitat component which is not commonly considered representative of the pinyon juniper type. Rivers, for example, which course through the P-J zone support ecosystems which are more or less divorced from the zone. This certainly does not diminish the importance of these systems nor their contribution to the P-J biota. However, when reference is made to wildlife of the pinyon juniper, ducks and water beetles do not normally come to mind. Perhaps the greatest influence the pinyon-juniper zone has on fish (Table 2) and related organisms is the silt load it may contribute to the water. The addition of gross quantities of fine sediments changes the community of aquatic organisms within a stream and diminishes

what does this say

The total productivity of the stream and may decrease the permeability of spawning gravel (McNeil and Ahnell, 1964; Cooper, 1965). Turbidity lowers stream productivity by decreasing light penetration and thereby limiting the growth of phytoplankton and other aquatic plants which are of major importance as basic foods for aquatic animals and as producers of oxygen by photosynthesis (Bullard, 1962; Gaufin, 1955).

One category of animals that requires special mention is the Rare and Endangered species (Table 3). Although several species are known to frequent the pinyon-juniper, in most instances, little data is available on their specific life histories. As is often the case with deficient information on a species, a controversy may arise as to whether or not that particular animal even exists. As an example, the California bighorn (Ovis canadensis californiana) has been reported by BLM districts in Idaho, Nevada, and Oregon although at least one author indicates they are now believed extinct (Clark, 1964).

The several species of pinyon and juniper provide cover and forage for a considerable number of animals. Pinyon nuts and juniper berries are consumed in quantity by chipmunks, squirrels and other small mammals as well as a host of birds. Both tree species are browsed to greater or lesser degrees by wintering mule deer. A recent Nevada study (Taush et.al., 1972) documents Utah Juniper as being a major item in the December-March diet of wintering deer. The true forage value of juniper is, however, not well understood and is subject of current studies. Findings by Nagy (1972) indicate

that under controlled conditions, his study animals would select the species of juniper which had the lowest volatile oil content. When three species of juniper were offered, his deer selected Alligator Juniper first followed in order by Rocky Mountain and Utah Juniper. It is not with the trees themselves that the greatest value lies however, but with the vegetal complexes they form with other plant species. As a rule, the greater the variety of habitat components there are, the greater the variety and abundance of wildlife. Forest openings and the "edge effect" they provide, are well documented as being invaluable to wildlife (Dasmann, 1971; Hosley, 1956; Patton, 1969; Reynolds, 1962, 1966; Trippensee, 1948). Also, evidence indicates that plants growing in forest openings have less crude fiber and greater sugar content making them more palatable than understory plants (Merrill, 1972).

[The relationship between pinyon-juniper and the associated vegetation is often inverse from a density and variety standpoint.] omit As pinyon-juniper density increases, quantity, quality, and variety of plant species under the tree canopy decrease (Aro, 1971; Burkhardt and Tisdale, 1960; Russo, 1964).

Competition of the sub-dominant understory plants with pinyon and juniper evidentally reduces their vigor and natural reproduction (Russo, 1964). Apparently, within their range, pinyon and juniper hold a considerable competitive edge over most other species (Tausch et.al., 1972). Should the dominance reach a dense closed pinyon-juniper climax, understory plants may be virtually eliminated

resulting in little protection for the watershed and practically no forage for wildlife. Almost without exception, this stage is least desirable for wildlife. Historically, fire and interspecies plant competition have been instrumental in creating and maintaining some semblance of vegetational diversity within the pinyon-juniper stands (Lyon, 1966; Leopold, 1924; Parker, 1945). To the trained observer, it is obvious that in many areas the rate of pinyon juniper invasion and its overall density is increasing. Some authors have indicated this is due in part to more efficient fire suppression and a reduction in plant competition through overgrazing (Arnold, 1959; Leopold, 1924; Lyon, 1966; Mason, 1963; Parker, 1945; Woodbury, 1947).

The pinyon-juniper association, which covers millions of acres in the western United States, is of utmost importance to a remarkable variety of wildlife. As indicated, this wildlife ranges from those animals more or less confined to the environmental elements of the zone to animals which function virtually independent of any specific life zone. In many areas, tree densities are reducing the zone's habitat potential.

Table 1

REPRESENTATIVE WILDLIFE OF THE
PINYON JUNIPER

MAMMALS

Artiodactyla

Mule deer (Odocoileus hemionus)
Whitetailed deer (Odocoileus virginianus)
Elk (Cervus canadensis)
Bighorn sheep (Ovis canadensis spp.)
Barbary sheep (Ammotragus lervia)
Pronghorn antelope (Antilocarpa americana)
Javelina (Pecari angulatus)

Carnivora

Mountain Lion (Felis concolor)
Bobcat (Lynx rufus)
Coyote (Canis latrans)
Bear (Ursus americanus)
Fox (Vulpes spp. & Urocyon spp.)
Badger (Taxidea taxus)
Weasel (Mustela spp.)
Raccoon (Procyon lotor)
Ringtail (Bassariscus astutus)
Skunk (Mephitis spp.)

Lagomorpha

Cottontail (Sylvilagus spp.)
Blacktailed jackrabbit (Lepus californicus)
Whitetailed jackrabbit (Lepus townsendii)

Rodentia

Marmot (Marmota flaviventris)
Prairie dog (Cynomys spp.)
Ground squirrels (Citellus spp.)
Gray squirrels (Sciurus spp.)
Chipmunks (Eutamias spp.)
Woodrats (Neotoma spp.)
Kangaroo rats (Dipodomys spp.)
Pocket gophers (Thomomys spp.)
Grasshopper mice (Onychomys spp.)
White-footed mice (Perymiscus spp.)
Kangaroo mice (Microdipodops spp.)
Harvest mice (Reithrodontomys spp.)
Pocket mice (Perognathus spp.)

Chiroptera (Representative Families)

American Leaf-nosed bats (Phyllostomidae)
Vespertilionid bats (Vespertilionidae)
Free-tailed bats (Molossidae)

BIRDS

Falconiformes

Golden eagle (Aquila chrysaetos)
Bald eagle (Haliaeetus leucocephalus)
Sharpshinned hawk (Accipiter velox)
Coopers hawk (Accipiter cooperii)
Goshawk (Accipiter gentilis)
Red tailed hawk (Buteo borealis)
Swainson's hawk (Buteo swainsoni)
Ferruginous hawk (Buteo regalis)
Sparrow hawk (Falco sparverius)
Pigeon hawk (Falco columbarius)

Strigiformes

Great horned owl (Bubo virginianus)
Long-eared wol (Asio otus)

Passeriformes

Pinon jay (Gymnorphinus cyanocephala)
Scrub jay (Aphelocoma coerulescens)
Stellers jay (Cyanocitta stelleri)
Black-billed magpie (Pica pica)
Raven (Corvus corax)
Crow (Corvus brachyrhynchos)
Clark's nutcracker (Nucifraga columbiana)

Piciformes

Flicker (Colaptes spp.)
Acorn woodpecker (Melanerpes formicivorus)
Lewis' woodpecker (Asyndesmus lewis)
Ladder-backed woodpecker (Dendrocopus scalaris)
Nuttall's woodpecker (Dendrocopus nuttallii)
White-headed woodpecker (Dendrocopus albolarvatus)
Hairy woodpecker (Dendrocopus villosus)

Columbiformes

Mourning dove (Zenaidura macroura)
White-winged dove (Zenaida asiatica)
Rock dove (Columba livia)
Band-tailed pigeon (Columba fasciata)

Galliformes

Wild turkey (Meleagris gallopavo)
Chukar partridge (Alectoris graeca)
Gambel's quail (Lophortyx gambelii)
Mountain quail (Oreortyx picta)
Scaled quail (Callipepla squamata)
Harlequin quail (Cyrtornyx montezumae)
Sage grouse (Centrocercus urophasianus)

Miscellaneous birds

Western Kingbird (Tyrannus veticalis)
Ash-throated flycatcher (Myiarchus cinerascens)
Gray flycatcher (Empidonax wrightii)
Cliff swallow (Petrochelidon pyrrhonota)
Black-capped chickadee (Parus atricapillus)
Plain Titmouse (Parus inornatus)
Common bushtit (Psaltriparus minimus)
Canyon wren (Catherpes mexicanus)
Western bluebird (Sialia mexicana)
Blue-gray gnatcatcher (Polioptila caerula)
Cedar waxwing (Bombycilla cedrorum)
Loggerhead shrike (Lanius ludovicianus)
Hutton's vireo (Vireo huttoni)
Virginia's warbler (Vermivora virginiae)
Black-throated gray warbler (Dendroica nigrescens)
Painted redstart (Setophaga picta)
Scott's oriole (Loterus parisorum)
Hepatic tanager (Piranga flava)
Western tanager (Piranga ludoviciana)
Black-headed grosbeak (Pheucticus melanocephalus)
Lesser goldfinch (Spinus lawrencei)
Brown towhee (Pipilo fuscus)
Harris' sparrow (Zonotrichia querula)
Nighthawk (Chordeiles spp.)
Townsend's solitaire (Myadestes townsendi)
Poor-will (Phalaenoptilus muttallii)
Roadrunner (Geococcyx californianus)

AMPHIBIANS AND REPTILES

Collared lizard (Crotaphytus collaris)
Great Basin spadefoot toad (Scaphiopus intermontanus)
Boreal toad (Bufo boreas boreas)
Rocky mountain toad (Bufo woodhousii)
Pacific tree frog (Hyla regilla)
Leopard frog (Rana pipiens)
Yellow-backed spring lizard
Great Basin fence lizard (Sceloporus occidentalis)
Northern sagebrush lizard (Sceloporus graciosus)
Horned lizard (Phyrynosoma spp.)
Great Basin skink (Eumeces skilton onus utahensis)

Great Basin Whiptail (Cnemidophorus tigris tigris)
Rocky Mountain rubber boa (Charina bottae utahensis)
Regal ringneck snake (Diadophis punctatus regalis)
Red racer (Mastiophis flagellum piceus)
Desert striped whipsnake (Masticophis taeniatus)
Great Basin gopher snale (Pituophis melanolencus deserticola)
King snakes (Lampropeltis spp.)
Wandering garter snake (Thamnophis elegans vagrans)
Desert nightsnake (Hypsiglena torquata deserticola)
Rattlesnakes (Crotalus spp.)

INSECTS (Representative Orders)

Ephemeroptera
Odonata
Plecoptera
Trichoptera
Orthoptera
Isoptera
Hemiptera
Homoptera
Neuroptera
Coleoptera
Lepidoptera
Diptera
Hymenoptera
Siphonaptera

Table 2

REPRESENTATIVE FISHES OF THE PINYON JUNIPER ZONE

Due to the great altitudinal and latitudinal variances involved, either warm or cold water fishes may be present.

FAMILIES

Ictaluridae	Catfish
Salmonidae	Trout, Whitefish
Catostomidae	Suckers
Cyprinidae	Carp, Squawfish, Shiners Minnows, Dace, Chubs
Cottidae	Sculpins
Centrarchidae	Sunfish, Basses
Percidae	Perches
Esocidae	Pikes

Table 2

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Bureau of Land Management, 1972. Fishes of the Elko BLM District, Elko, Nevada.

Everhart, W. H. and W. R. Seaman. 1971 Fishes of Colorado. Colorado Game Fish and Parks Division, Denver. 75 p.

Table 3.

*Rare and Endangered Species of Wildlife

Note: Some of these animals may not be in the pinyon-juniper association. Very little life history data is available on these species at this time.

Endangered

Species	States reported in
Sonoran pronghorn (A. a. sonoriensis)	Arizona
San Joaquin Kit fox (Vulpes macrotis mutica)	California
Black footed ferret (Mustela nigripes)	Colorado, New Mexico, Montana Utah, Wyoming
Columbian white tail deer (O.V. Leucurus)	Oregon
S. Bald eagle (Haliaetus leucocephaphlus (L.))	Ariz., Calif., Colo., Nev. N. Mexico
Am. Peregrine falcon (Falco peregrinus anatum)	Idaho, Mont.
Masked Bob-white (Colinus virginianus ridgwayi)	Arizona
California condor (Gymnogyps californianus)	Calif.
Blunt nosed leopard lizard (Crotaphytus silus)	Calif.
Gila topminnor (Poeciliopsis occidentalis)	Ariz.
Colorado River Squawfish (Ptychocheilus lucius)	Ariz., Calif., Colo., Utah., Wy
Tecopa pupfish (Cyprinodon nevadensis calidae)	Calif.
Owens river pupfish (C. radiosus)	Calif.
Devils Hole pupfish (C. diabolis)	Calif.
Humpback chub (Gila cypha)	Utah
Mojave chub (G. mohavensis)	Calif.
Woundfin (Plagopterus argentissimus)	Ariz., Utah
Lahontan cutthroat trout (Salmo clarkihenshawi)	Idaho, Nev., Oregon, Wyo.

Rare

Spotted bat (Euderma maculatum)	Ariz., Calif., Colo., Nev., N.M.
Utah prairie dog (Cynomys parvidens)	Utah
California bighorn (Ovis canadensis californiana)	Idaho, Nev., Oregon
Penninsula bighorn (O. C. cremnobates)	California
Warm spring pupfish (Cyprinodon nevadensis pectoralis)	Nev.
Pahrump killifish (Empetrichythys latos)	Nev.

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* From 1972 List of Rare and Endangered Species of Wildlife reported on lands administered by the Bureau of Land Management.

3. Humans

The association between modern man and the pinyon juniper community is primarily that of (1) recreational pursuits (2) grazing of livestock, (3) harvesting of some woodland products such as pine nuts, cord wood and fence posts. With the exception of the use of these lands for forage products for both domestic livestock and big game animals, the use of these lands by modern man is incidental. It is primarily related to aesthetics, open space values and similar recreation opportunities.

However, historically, these lands were considered valuable for the products harvested by both early pioneers and indigenous Indian tribes. There is historical evidence to indicate that among the southern Piute cultures, pinyon trees were claimed as property by the women of the local tribe. These trees were considered primarily valuable for their pine nuts and trespassing on one's property usually led to inter-tribal disputes. (5) Pine nuts were said to yield a meal suitable for mush. Dried nuts were stored for the winter and used whenever the occasion arose. Utah juniper berries were also harvested in a similar manner, crushed and utilized whenever necessary.

In 1909, USDA silvica leaflet #47 refers to the value of pinyon for fuel wood, small poles and posts, railroad ties, mine lagging and as a source of edible seeds. These forests were also considered as having some value as a protective cover to prevent erosion. Pine nuts are still traditionally harvested by some Indian cultures. Attempts to establish profitable commercial

development for essential oils, charcoal and sawn wood products have met with limited success.

Disposal of Pinyon-Juniper Woodland Products (1967 thru 1971)

	Posts (No.)	Xmas Trees (No.)	Firewood * (Cords)	Pine Nuts (Lbs.)
Alaska	56,500			
Arizona	226,894	5,612	890	
California	25,918	37,837	10,502	
Colorado	229,750	22,819	53,549	
Idaho	228,350	4,744	1,336	
Montana	219,585	800	46	
Nevada	452,731	273,692	50,476	800
New Mexico	126,704	4,435	49,626	
Oregon	970,473	500	42,274	
Utah	767,875	36,516	28,698	1,070
Wyoming	265,289	-	735	
Total	3,570,069	386,955	238,132	1,870
Average Stumpage	$0.10	$1.00	$2.00	0.10
Value	$357,007	$386,955	$576,264	$187
				$1,320,413

The sale of Christmas trees, cord wood and fence posts still continues, with Christmas trees and cord wood being considered the most feasible over the major portion of the range of the P-J type.

* how much of this came from chained areas

C. Ecological Interrelationships

The woodland community ecosystem, because of its past history of overuse and its relationship to other associated communities is still in a transition stage. There is sufficient evidence to indicate that woodland communities, especially junipers, have extended themselves into former grasslands and sagebrush sites. This trend is still in evidence and it is expected to continue until surface management practices come into balance with climatic, site and environmental factors.

expand use Rice pictures

There is a close relationship between the woodland ecosystem and fire. Under a natural system, fire was probably the major factor in maintaining a proper balance between the woodland and adjacent plant communities. Modern concepts of fire protection have significantly contributed to the expansion of pinyon juniper woodlands at the expense of grass and brush types. Changing use patterns have also allowed woodland communities to expand. Pinyon-juniper areas that normally have been harvested by local residents for cord wood, fence posts, etc. are now used primarily as recreation and open space areas.

Little information is available in regard to the energy and nutrient cycles on woodland communities.

D. Aesthetics

1. Visual. The Pinyon-juniper visual environment is one that varies greatly. The very nature of the type puts it in a semi-desert situation and primarily into the foothill areas of the west. The stands themselves vary from a dense continuous canopy of P-J

to an open scattered random pattern. The terrain varies from relatively flat valley bottoms through low rolling foothills to deep-cut canyons and high mesas.

Since the valley bottoms in the west are also the principle travel routes, much of the pinyon-juniper type is exposed to the view of the travelling public. In some areas this view is from a considerable distance. In others, it is directly adjacent to the travel route.

The aesthetic qualities of woodland communities are such that a sense of open space and vastness is created by the seemingly endless expanse of trees. Actual visitor use information is lacking to support the contribution of this plant community to the physical recreation needs of the public.

E. Human Interest Values

1. Educational/Scientific

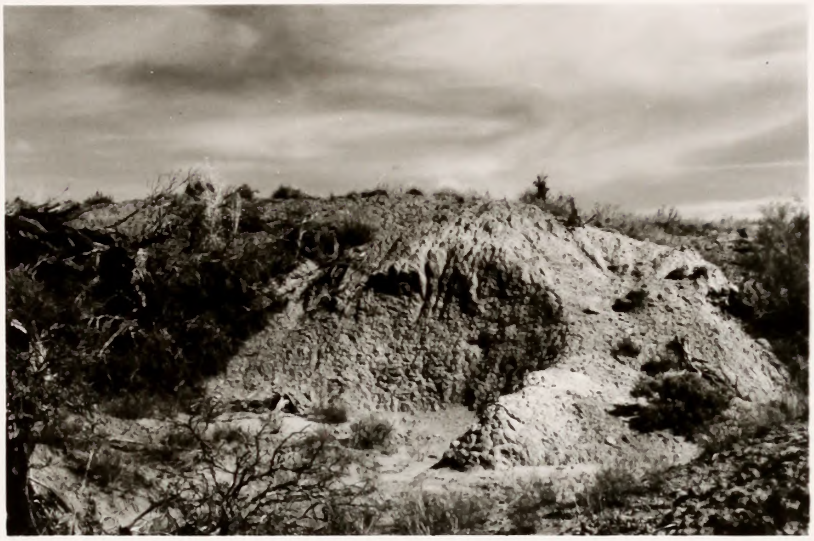
The educational value of these lands has been overlooked. At the present time there appears to be an increased interest in these lands for use as outdoor classrooms, for survival training and for environmental workshops.

2. Historical

These lands play a significant role in a cultural and historical past of the western frontier. They are traversed by several major overland migration trails such as the Mormon Trail, the old Spanish Trail, the Pony Express Trail, etc. An inventory would be necessary to properly assess the historic value of these lands.

3. Cultural

Pinyon juniper woodlands in Eastern Utah and Western Colorado, as well as portions of Arizona and New Mexico contain a very significant accumulation of early American Indian sites. In Utah alone, it is estimated that 20,000 archeological sites are found within or adjacent to pinyon juniper lands and it is reasonable to assume that comparable land areas would also contain the same amount of cultural artifacts. The present use of these lands by remnant Indian populations is probably sporadic and related only to seasonal harvesting of woodland products such as pine nut and fuel wood. In the majority, woodlands located within existing Indian reservations probably provide most of the cultural needs of these people.



Erosion in chained area

was. this caused by chaining

III. Environmental Impact of Proposed Action

A. Non-living Components

1. Land and Water

The environmental impact of pinyon-juniper manipulation on overland flow and sediment production is very complex and a complete understanding of the interactions of the various environmental components are not thoroughly known or understood. There are many factors which affect overland flow and/or sediment production, these do not necessarily express themselves to the same magnitude at every location where pinyon-juniper stands occur.

One component of the watershed environment does seem to express itself as the probable most important item to consider at any location where P-J manipulation is being contemplated; that is the percentage of ground cover and the percentage of bare ground present prior to treatment and that which can be reasonably expected to manifest itself within a reasonable time after treatment.

Research work throughout the Western United States has shown the importance of vegetative cover on overland flow and sediment produced from numerous watersheds. Noble (1965) reported a marked decrease in both runoff and sediment production from watersheds well protected with plant litter and plant cover.

He showed that watersheds with 60-75% of the ground covered with either litter or plants yielded less than 1/2 tons per acre of sediment, and only 2% of the rainfall ? runoff while the watersheds

with 10% of the ground covered with litter or plants yielded 5.5 tons sediment per acre while 73% of the rainfall runoff. Meeuwig (1971) working in high elevation range lands, demonstrated erosion was more closely related to amount of watershed cover than any other site characteristic. The relationship between erosion and cover was strongly influenced by slope gradient. His regression analysis indicated that erosion was about the same on a 5% slope with a 40% cover as it was on a 35% slope with an 80% ground cover.

Cooperrider and Hendricks (1937) studying the upper Rio Grande watersheds have stated that where protective ground cover has been reduced as little as 7% but as much as 39% moderate erosion was in progress, but where the protective cover has been reduced by 52 to 74% excessive soil erosion was manifested in rapid land destruction.

Renner (1936) working on the Boise River Watershed stated that a protective cover of less than 30% appears to have little effect in retarding erosion but that as the cover increased above that point erosion decreased rapidly so that a protective cover of 40% was sufficient to prevent gully erosion. At the same time, Renner has shown that the type of vegetation making up the protective cover has a marked influence on the erosion condition as does the aspect of the site.

Craddock and Pearse (1938) working in the same area as Renner reported runoff and soil loss values for four range types within the Boise River Watershed. Wheatgrass range yielded 5% of the

precipitation as runoff and 0.003 tons per acre soil loss from a moderate to heavy rainfall on a 30-40% slope gradient. While Downey Chess yielded 25.5% runoff and 1.05 tons per acre soil loss, Lupine needlegrass site yielded 49.9% runoff accompanied by 2.38 tons soil/per acre, and an annual weed type produced 60.8% runoff with a soil loss of 7.64 tons per acre.

Humphrey and Lister (1941) substantiated these previous findings.

Johnson and Niederhof (1941) also demonstrated the relationship of runoff and sediment production to various range cover types when they compared abandoned field cover to Valley Bunchgrasses and mountain bunchgrasses. They reported a three fold increase in runoff from abandoned fields, as compared to the mountain bunchgrass type. However, the amount of eroded material carried per cubic foot of runoff showed no significant increase from one type to the next. They believed this to be due to soil texture and slope gradient differences.

Packer (1951) compared overland flow and erosion on wheatgrass ranges to cheatgrass ranges. He found runoff varied from 0-28% on wheatgrass sites as compared to 4-42% on the cheatgrass sites.

Eroded soil from the wheatgrass plots varied from 0 to 3,358 pounds per acre while the cheatgrass plots yielded 462 to 3,620 pounds per acre. In both types, ground cover density was the single characteristic most highly correlated with overland flow, while maximum bare ground openings was that characteristic most highly related to soil erosion.

Turner and Dortignac (1954) substantiated the correlation of bare ground to soil loss in Colorado. They presented the following information:

Rangeland type	% Bare Soil	Lbs./Acre Soil Loss
Dense Thurber Fescue	6	76
Openstand Thurber Fescue	19	646
Bluegrass	14	455
Needlegrass	38	1068
Lush Weeds	28	788
Poor Weeds	58	4375

Branson and Owen (1970) working on 17 watersheds in Western Colorado present different findings, they could not find a statistically significant between percent bare soil and sediment yield, however, they found a highly significant correlation between percent bare soil and runoff.

It would appear from these data that the removal of P-J trees from a watershed would have the effect of increased water and sediment yield. However, two studies on rather large areas in Arizona do not support this conclusion. Brown (1970) working on the Beaver Creek Watershed reported a pilot test has shown no increase in either streamflow or sediment yield following the removal of Utah juniper. Collings and Myrick (1966) studying the effects of juniper and pinyon eradication on streamflow from Corduroy Basin found no significant increase in water yield due to the partial clearing.

Perhaps, the reasons for no measurable increase in overland flow or sediment production from large watershed studies can be explained partially by other findings. Skar (1961) reported cabling of juniper produces surface depressions which annually trap an estimated 0.09 to 0.27 inch surface flow, this could, in part, explain why there is no increase in runoff following P-J manipulation on large areas. The factor of soil wettability varied widely between various ground cover zones. Resistance to wetting in the surface soil varied from completely wettable in open areas to highly non-wettable in the litter under the juniper canopy. Resistance to wetting decreased with depth in the soil profile below the litter zone. By use of regression analysis he showed a good correlation between wettability and organic matter.

The results support the general concept that the source of the substance producing non-wettability in the soil is the fresh or decomposing organic material. From his study he reports it appears to be the decomposing litter which causes the problem. Based on this study, the ground disturbance under and around the juniper tree as it is moved from place may decrease the percentage of non-wettable soils within the treatment area. The fact soils can be made hydrophobic was also reported by Letey, et. al., (1961) and by Kramer (1965). Kramer reported this substance to be an organic coating on the soil particles following wild fires, while Letey, et. al., reported medium grained beach sand can be made hydrophobic by treatment with ammonium hydroxide extract of chaparrallitter. This phenomena increased the time it took water to enter the sand by a factor of 2 or 3.

This fact could be repeated in nature under juniper canopies in the decaying organic matter where ammonium is formed in the nitrogen cycle when rain fall combined with the ammonium to form ammonium hydroxide the same hydrophobic soil phenomena could be produced. With the disturbance of the decaying litter, this process could be reduced greatly and actually increase the areal infiltration rate of the soils.

This hypothesis is somewhat substantiated by Giffard (1969) when he found double chaining of pinyon-juniper with debris left in place did not significantly affect infiltration rates while adding a supplemental treatment of windrowing the debris did increase permeability of the surface soils significantly.

Giffard offers a suggestion that the windrowing plus chaining is similar to light plowing which increases non-capillary porosity through the decrease in bulk density and incorporation of litter into the surface soils. Williams, et.al., (1972) reporting further on Giffard's work of infiltration studies has stated the most important factors in predicting infiltration included:

1. Total porosity in the 0-3 inch level of soil;
2. Percent bare soil surface;
3. Soil texture in the 0-3 inch level; and,
4. Crown cover in percent or tons per acre.

These variables would also affect the non-wettability of soils as reported previously.

Perhaps one important environmental component which helps dictate the impact on the watershed environment is the amount and type of litter material and the amount of soil incorporation which is accomplished during the P-J manipulation treatment. Meeuwig (1971) has stated the most important soil parameter affecting erodibility was the amount of organic matter but the direction and magnitude of its effect depends on the soil texture. That is organic matter decreases erosion of clay soils but tend to increase erosion on sandy soils.

The available soil moisture for vegetative growth could possibly be affected by a P-J manipulation on a given area. Skan (1960) found that juniper trees intercept about 40% of the precipitation that falls on the crown, but that a small portion of this is recovered as stemflow and in some storms may provide additional moisture near the base of the tree. The U. S. Forest Service (1969) reported the amount of rainfall through a forest canopy decreases with increasing canopy density and stemflow increases with tree size. With a 41% canopy density 81% of the rainfall reaches the ground, while a 66% canopy density allows 84% of the rainfall to reach the ground. As mentioned previously Skau (1961) reported the soil surface depressions trap an estimated 0.09 to 0.27 inch surface flow. It is quite possible these two findings compensate for each other. Studying the effect on soil moisture further Skau (1964) reported that even though cleared plots of Utah juniper and alligator supported from 1 to 9 times more ground cover the soil moisture was higher on the cleared plots. The alligator juniper plots averaged 1.1% more soil moisture than the control while the cleared Utah Juniper plots had 2.5% more moisture than the control

plots. He concluded that clearing of juniper may considerably increase water for forage production but that clearing will have little effect on water yields insofar as they are influenced by soil water storage in the upper 24 inches.

2. Air

Air pollution from wind borne dust particles would be increased significantly in the immediate area for the following reasons:

1. Loosening of the soil mantle by mechanical disturbance.
2. Increased wind velocities at ground level due to removal of tree canopy.
3. Temporary removal of most plant cover.

Research work in progress by Giffard indicates that wind velocity is some three times greater in chained areas than in adjacent undisturbed P-J stands.

B. Living Components

1. Plants

Grasses and forbs are generally not seriously disturbed by the chaining operation. Some plants are killed by mechanical disturbance but the overall effect is to release these plants by reducing competition from woody plants for the limited moisture available in the ecosystem.

Damage to brush and shrubs is more serious with generally 10 percent killed in the double chaining process. Sprouting and release tends to affect this loss within five years.

Pinyon and juniper trees over seven inches in diameter are uprooted and killed. Young trees largely survive this type of treatment and those in the 2-3 inch diameter class are benefitted by the same type of release noted above for brush and shrubs.

Since 1960, approximately 514,000 acres of the Pinyon-juniper type on BLM administered lands in the West has been chained. This represents about 3% of the 20,000,000 acres of this woodland type occurring on Bureau managed lands. The following table depicts the chaining, which has been carried out, by state, by year since 1960:

Pinyon Juniper Chaining
On Lands Administered by BLM

scal Year	Arizona	Calif.	Colo.	Idaho	New Mex.	Oregon	Utah	Nevada	Bureau Total
1960	11,960		6,436		-0-		15,048	6,742	40,186
61	13,463		2,030		1,388		11,185	3,300	31,366
62	2,200		6,652		3,057		10,456	-0-	22,365
63	7,725		14,168		6,929	550	12,006	5,384	46,762
64	15,476		21,712		10,468		11,824	3,795	63,275
65	2,832		10,837		7,214	2,980	24,597	3,905	52,365
66	-0-	60	13,084		8,288		39,385	3,354	64,171
67	3,870		11,399		1,379	1,450	57,178	4,077	79,353
68	1,808	198	1,168		4,603		23,499	2,843	34,119
69	1,309	650	2,563	1,421	2,297	1,600	23,749	1,520	35,109
[illegible]	-0-		1,437		636	200	24,787		27,060
71	-0-	577	1,801	2,000	-0-	335	3,350	6,958 A/	15,021
72	-0-	-0-	-0-	1,200	-0-	850	-0-	780	2,830
Total	60,643	1,485	93,287	4,621	46,259	7,965	257,064	42,658	513,982

2. Animals

a. Wildlife

Properly designed chainings of dense pinyon-juniper stands on carefully selected sites can be of significant value to many species of wildlife. If management objectives are directed toward creating a grass/forb/shrub complex with recognition given to the proximity of cover, most habitat requirements of a wide variety of animals will be met.

As increased stratification and variance in vegetation is realized, the insect population can be expected to expand followed with an increase in insect eating birds and mammals. Depending on the particular site involved, the food supply for many reptiles and amphibians may also be enhanced. Animals which utilize the roots, stems, leaves, and/or seeds of the plants can be expected to increase. Nesting sites for a considerable number of birds and small mammals will also be increased. The above animals will in turn attract a variety of predatory mammals, birds, and reptiles. The downed trees and establishing shrubs, grass, and forbs provide escape cover for these prey species.

Most of the estimated 1,192,000 deer on public domain lands in the west (BLM, 1971) winter in the pinyon-juniper zone. Many thousands of acres of prime winter range have been and are being lost to urban expansion, water development, highways, and other human related activities. Widespread overuse of ranges by livestock and game animals and increasing densities of pinyon-juniper have also taken their toll.

Converting dense stands of pinyon-juniper to a mixed grass/forb/ browse type will help alleviate some of the problems of declining winter ranges by providing more abundant and diverse forage. Forage diversity is of considerable importance in the diet of mule deer (Dasmann, 1970; Dietz, 1957; Hill, 1956).

More benefit will be realized from chaining if adequate cover for escape from predators and the elements is retained. The moderating effect woody cover has on wind velocity and temperature can be of considerable importance, particularly during the winter (Loveless, 1967). Banks of trees also effectively dampen sound to levels tolerable by wildlife in areas where noise from highways and other sources may be potentially influencial in habitat usage (Cook et.al., 1971, A. Lorin Ward, 1972).

An Arizona study indicated that most deer use of clearings occurred within 600 feet of forest cover with decreasing use out to 1200 (Reynolds, 1966). This is in close agreement with the recommendation by Minnich (1969) that any point within the chained area not be more than 1/8 mile from undisturbed forest. Topographical variances and/or downed trees in the control area may often meet the escape cover needs of mule deer allowing some modification of control width. A recent study indicates that chained area use by another important game animal, the cottontail rabbit, can be increased by retaining some combination of 70-90 down, dead trees and living shrubs per acre (Kundaeli and Reynolds, 1972). Chaining undoubtedly imposes considerable stress on those animals in and immediate to the control area during the chaining operation.

Some residual adverse effect on some species may be incurred but the great percentage of animals accommodate such environmental disturbance to a remarkable degree and the detrimental effects of the chaining can be expected to be short term. Project design should provide for the exclusion from control of specific topographic areas which, for one reason or another, wildlife show a particular preference for or are frequented by any rare or endangered species. Certainly, live streams, marshes or other aquatic habitat should not be chained over.

It must be recognized from the outset that chaining pinyon-juniper does not automatically equal wildlife habitat improvement. Not every pinyon-juniper stand has the potential to produce significant wildlife benefits due to poor soils, low precipitation or other limiting factors. Careful evaluations must be made before any site is selected for control. Once a site is selected, the control work has to be judiciously designed and implemented if optimal wildlife values are to be realized. Subsequent management of the control area is also of paramount importance if long-term wildlife benefits are to be obtained.

b. Domestic Livestock

Closed stands of pinyon-juniper produce very little understory vegetation (Arnold, Jameson and Reid, 1964). Such stands require an average of 36 surface acres to produce sufficient forage to sustain one cow, or its equivalent, for a period of one month (Animal Unit Month, or AUM).

The proposed action will result in the establishment of vegetation which is available for livestock consumption. This action on past BLM projects has yielded sufficient forage to support an animal unit month on 8 surface acres. This has resulted in a 4 fold increase in the ability of the land to support livestock grazing.

Native forage species occurring after the proposed action are numerous. Primary native forage species occurring by region are listed in Appendix 1.

B. Living Components

3. Humans

a. Woodland Products

From a woodland products standpoint, chaining is generally detrimental. Pinyon nut production would be virtually eliminated for perhaps as long as 100 years. The production of fence posts and Christmas trees is adversely affected for a period of from 10 to 30 years. Total effects necessarily depend on the age class of trees involved. The supply of dead trees for fire wood is significantly increased. Not infrequently the very small trees survive and exhibit accelerated growth as a result of competition reduction with mature trees which could increase site potential for Christmas trees. Should virtually all trees be eliminated, reestablishment from natural seed sources could not be anticipated for 30 to 50 years.

C. Ecological Interrelationships

The removal of the P-J overstory provides a site from re-establishment of a perennial grass type. With proper management which eliminates over-use, such a type can be substituted for P-J as the climax type on the site.

D. Aesthetics

There are five basic elements which make up the character of the landscape -- line, form texture, color and scale. Pinyon-juniper chaining projects affect four of those five elements. Except in very open stands, the edge of the chaining project creates a defined line between the area that has been chained and the remaining stand. The texture changes from a canopied woodland to an area of piled debris, uprooted stumps and exposed soil. The color is changed from the green canopy cover to that of the exposed soil and dead remnants of the stand. The scale of the openings in the canopy is changed drastically from the small openings between the individual trees to a large single opening between the edges of the project. The affect these changes have on the visual environment varies with the density of the stand and the size and shape of the project. The visibility of the project to the viewing public depends upon the proximity to travel routes or population centers, the degree of slope, and the aspect.

1. Ground Observation. A chained area which reflects the size and shape of natural openings has much less impact when viewed from a distance than one which is insensitive to the same two factors. Because dead and dying trees and stacks of debris

connotate an unhealthy condition, any project using the proposed action will have an extreme impact when viewed from a close-up position. A project which is on a relatively steep slope in direct view from a travel route or population center will have a much greater impact on the viewing public than one which is relatively hidden.

2. Aerial Observation. Much of the same criteria that affects ground observation can be used in describing the effects on the aerial observer. Because most air travel occurs within fairly defined air corridors, these should be considered as another form of travel route. Degree of slope and aspect have very little effect on the impact to the aerial observer, but the opportunities for a close-up view are limited. The size and shape of the project have more influence on the degree of impact than any of the other factors.

E. Human Interest Values

1. Visitor Use

The effects of chaining pinyon-juniper areas on recreation visitor use are closely tied to several other major topics proposed for discussion in the outline. Of these topics, those of primary concern are (a) impact on wildlife as related to hunting and observation of wildlife populations. To the extent that these populations are enhanced or diminished there will be a resulting effect on increased or decreased visitation for these activities. (b) Impact on aesthetics - One of the activities most engaged in by the public is driving for pleasure. This driving is

primarily for the purpose of viewing outstanding scenery. To the extent that projects can be designed to enhance the natural scenery, or to the extent that a given project will diminish scenic values, there should be a resulting effect on visitor use for this purpose.

(c) Impact on Woodland Products - Cutting the family Christmas tree would no longer be a potential use activity in chained areas. Pine nut hunting would no longer be a use activity in project areas. Obtaining firewood for the family fireplace could be a use activity that would be greatly enhanced, especially in areas where pinyon pine is chained. Juniper, on the other hand, is not a desirable species for this use.

Regardless of the numbers of projects, size of projects, project areas, or treatment methods, there will remain theoretically no change in the numbers of persons or the number of visitor days of time spent in the pursuit of recreation, so it theoretically could be concluded that there would be no change in the total amount of recreation use but would, in fact, continue to increase at a rate proportionate to increase in population, disposable income, and disposable time. Changes to be expected would be in the form of a shift in use areas and/or recreational activities depending on the overall positive or negative impacts on the above resources, including total impact on resources not discussed above. This shift would be tied to the quality or quantity of recreation experience an individual may be seeking.

2. Historic Sites

Most historic sites can be identified and protected prior to a given project, but these values are sometimes inadvertently overlooked or are not recognized. When this happens, a project could completely destroy these sites. In the event that this happens, the given historic site could lose practically all of its value for cultural enjoyment by the public and cannot be entirely replaced.

3. Cultural

Archaeological sites vary with each different geographical location, ex. Pueblo ruins, pit houses, tipi rings, mounds, and various other prehistoric and historic structures found over the west and Alaska. Whether or not an archaeological site should be chained varies with its description and physical condition. Single chaining vs. double chaining of archaeological sites is another problem. Double chaining of certain sites would accentuate what may have already been partially destroyed through single chaining.

A discussion of effects of chaining of certain types of sites is not appropriate.

a. Protruding features of historic or prehistoric archaeological sites, such as walls, whether high or short, will be completely destroyed and should be avoided.

b. Any areas, mounds, depressions, chippings area, campsites, etc. with heavy vegetation and trees should not be

chained as pulling out of roots will certainly destroy features as well as scientific knowledge to be obtained from stratigraphy. Alternatives would be hand cutting of trees from sites with trees hauled away by hand. Tractors should never be allowed near any archaeological site with the exception of certain insignificant sites. Again, every site does pose different problems and should be dealt with accordingly.

c. Flagging or marking of sites, leaving trees on sites also calls attention to the area and increases the problem of destruction through vandalism and pothunting. Again, an alternative would be to hand cut trees from sites to eliminate calling attention to the area.

The recreational potential of archeological sites ideally would be based on environmental similarities to the period of original occupancy. By chaining an area, in an archeological context, along with destroying the aesthetics, the original or near to original relationship is destroyed. Sites without recreational potential would not be environmentally destroyed.

Appendix I

Principle Native Plant Species Commonly Associated with the Pinyon-Juniper Woodland

Grasses:

Scientific Name	Common Name
Oryzopsis spp.	Ricegrass
Bouteloua gracilis	Blue gramma
Bouteloua eriopda	Black gramma
Stipa spp.	Needlegrass
Sitanion hystrix	Bottlebrush squirreltail
Agropyron spicatum	Bearded bluegrass wheatgrass
Hilaria jamesii	Galleta
Festuca idahoensis	Idaho fescue
Poa spp.	Bluegrass
Bromus tectorum	Cheatgrass brome
Sporobolus cryptandrus	Sand dropseed

Forbs:

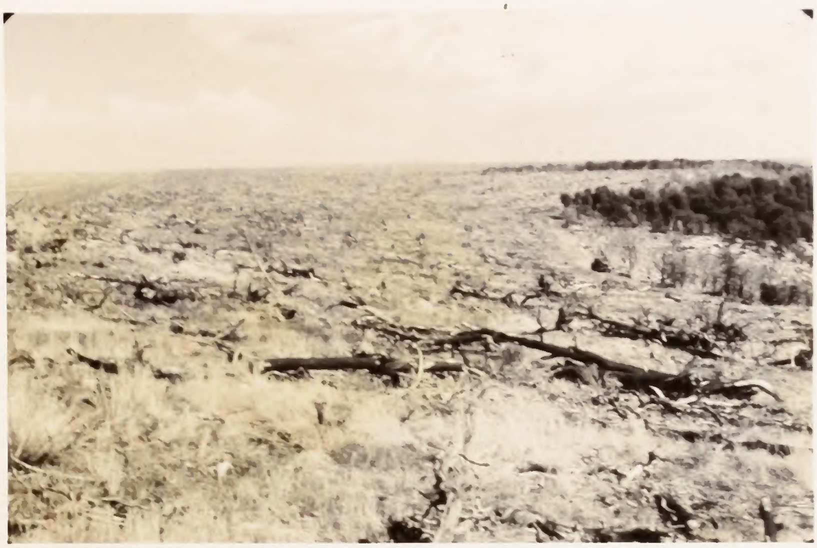
Scientific Name	Common Name
Artemisia ludoviciana	Louisiana sagebrush
Salsola kali	Russian thistle
Phlox spp.	Phlox
Sphaeralcea spp.	Globemallow
Eriogonium spp.	Eriogonium
Lupinus spp.	Lupine
Astragalus spp.	Locoweed
Leptodactylon pungens	False phlox

Shrubs:

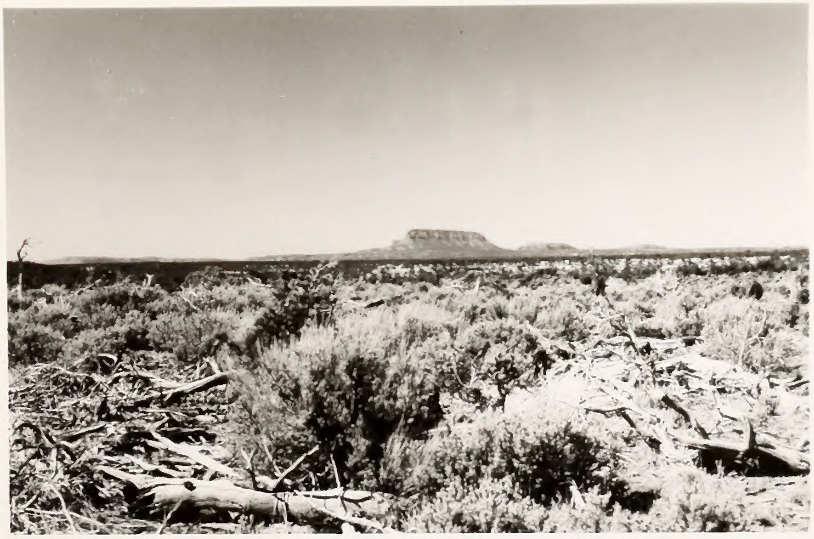
Scientific Name	Common Name
Artemisia nova	Black sagebrush
Artemisia tridentata	Big sagebrush
Grayia spinosa	Spring hopsage
Ephedra viridis	Green ephedra
Gutierrezia sarothrae	Broom snakeweed
Purshia tridentata	Antelope bitterbrush
Cowania stansburiana	Stansbury cliffrose
Amelanchier spp.	Serviceberry
Atriplex canescens	Fourwing saltbush
Cercocarpus montanus montanus	True mountain mahogany
Chrysothamnus spp.	Rabbitbrush

Shrubs (cont'd.)

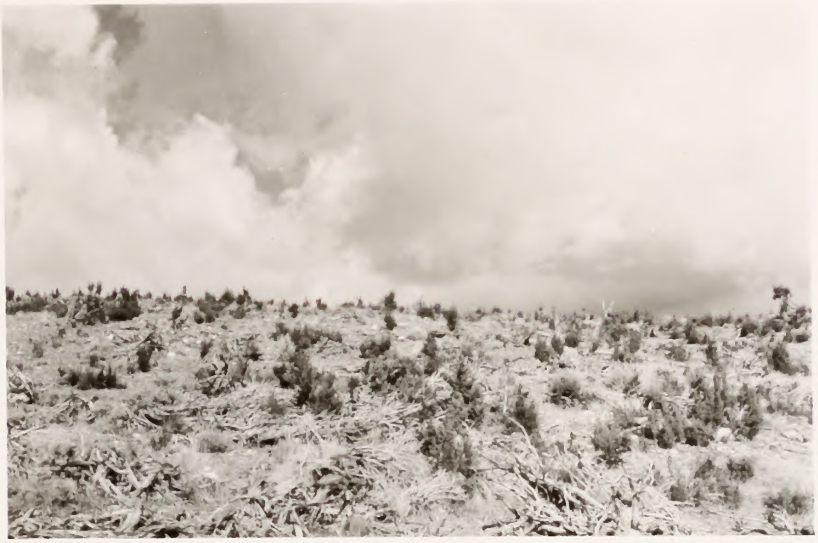
Symphoricarpos spp.	Snowberry
Arcocarpus ledifolius	Curlleaf mountain mahogany
Acacia greggii	Whitethorn
Eurotia lanata	Winterfat
Yucca spp.	Yucca
Quercus spp.	Oak



Double Chained, burned and seeded
Several years after treatment



Double chained, debris in place, several years after treatment



Single chained, debris in place
Area several years after treatment

IV. Mitigating Measures

A. Piling and Burning

1. Non-Living Components

Piling and burning of debris have adverse effects upon the soil and increases the erosion potential. The burning reduces soil wettability in the surface horizon of the solum. Piling or windrowing the debris has some beneficial effects in that the runoff is decreased and the infiltration rate is increased. These benefits come from the mechanical action of the debris being moved over the surface. Air pollution from smoke during burning and dust particles because of increased bare surface would be detrimental effects.

2. Living Components

a. Plants

Piling and burning results in the elimination of a large percentage of the young trees which survive the double chaining treatment. Generally, grazing capacities are not improved by this practice over capacities resulting from the proposed action. The benefit derived from the addition of surface area to produce forage appears to be off-set by the creation of a more xerach ecosystem. No research data is available which directly relates to this premise. However, Arnold et.at. (1964) did find that a light layer of slash left after clearing favored re-establishment of grasses and forbs.

b. Animals

Double-chaining tends to leave the downed trees in loosely defined windrows and/or piles. These accumulations of trees provide cover

for a variety of animals, particularly when there is snow on the ground. A jungle of uprooted trees, however, may actually limit use of the area by deer and rabbits (Russo, 1964; Kundaeli and Reynolds, 1972), as well as other animals. Burning of the piles removes this cover entirely, and if done on the whole area, is adverse to wildlife.

c. Humans

More of the young trees would be killed using this technique which would eliminate the possibility of a successful Christmas tree program in the short run. Cutting of firewood would be eliminated, since most of the material would be consumed in burning.

3. Ecological Interrelationships

The change in the ecosystem would be more drastic since even the young pinyon-juniper trees, would be essentially eliminated.

4. Aesthetics

Piling and burning almost entirely eliminates the debris that is left on the ground after a chaining project, and therefore also eliminates most of the impact to the close-up viewer. This practice has little effect on the overall long range view or on the aerial view. Again, it is the size and shape of the project which determines the long distance impacts.

5. Human Interest Values

The impact of burning on archeological features depends upon the nature of the sites and their remaining structual features. Most sites with surface evidence would be adversely affected by burning with the exception of chipping sites.

B. Chaining along Contour

1. Non-Living Components

When the chaining is done on the contour, the heavy anchor chain and the debris carried by the chain both plow the surface and create furrows. These furrows decrease the runoff, sediment yield and erosion and increase the infiltration rate.

2. Living Components

Contour chaining would not change the impacts on plants, or animals.

3. Aesthetics

Chaining along the contour probably makes very little difference to the overall impact on aesthetics.

C. Single Chaining

1. Non-Living Components

Single chaining would provide a lesser beneficial effect in reduced runoff and soil erosion and increased infiltration rate, than that produced by the proposed action.

2. Living Components

a. Plants

Single chaining would probably have the least adverse impact on the pinyon and juniper trees with only 2/3 as many trees killed. Impacts on other plants would be similar to the proposed action, but less mechanical damage would occur since the machinery would be crossing the area only once.

b. Animals

Single chaining would produce less pinyon juniper kills and therefore a lesser increase in forage production.

c. Humans

Single chaining would significantly reduce the adverse impact on woodland products. Fuel wood could be salvaged from the larger killed trees. Sufficient pole and seedling size trees would survive, to insure subsequent production of fence posts and Christmas trees, assuming proper initial stocking.

3. Aesthetics

Single chaining will have much the same impact as the proposed action. The major difference is the lack a total kill may leave a spotty pattern when viewed from a distance, and the bent over partially killed trees would add to the disarray and unhealthy connotation in the close-up view.

D. Artificial Seeding

1. Non-Living Components

a. Water

The amount and kind of protective cover which replaces the tree canopy cover following a P-J chaining has a large effect on overland flow and sediment production. In most heavy stands of P-J, the understory perennial vegetation would have large openings since very little perennials exist directly under the trees; therefore, it would alleviate some of the long range impact on watershed if the area is seeded immediately following the chaining.

In most areas pinyon and juniper grow in a climatic zone where two definite precipitation patterns and periods exist. There normally is a fall-winter precipitation period, which is received in the form of snow and favors an early spring growth period for cool season grasses and shrubs. The other period of precipitation usually is in the summer and early fall in the form of thunderstorms. This precipitation period favors warm season grasses. Therefore, the species planted should coincide with the most dependable precipitation period of the area.

b. Soils

Establishment of ground cover through artificial seeding will greatly reduce the exposed soil areas subject to soil loss through water or wind erosion.

2. Living Components

a. Plants

Artificial seeding will enhance the re-establishment of a plant cover on the site. The special composition of the artificial seeding will generally take a predominate position in the newly established plant community, and if properly selected will provide a beneficial ground cover and forage potential. Artificial seeding as a project feature after chaining should not have any impacts on the growth and development of the residual woodland community. Dense stands of grass however, may have an adverse impact on re-establishment by seedlings.

b. Animals

1. Wildlife

There are relatively few closing and closed stands of pinyon-juniper in which artificial seeding may not be required. In determining the necessity of seeding, Plummer (et.al. 1968) indicates that at least one desirable shrub and 10 desirable herbs per 100 square feet should be present if satisfactory improvement is to be realized without seeding. Generally, however, seeding is required if optimal forage composition and production is to be realized. It is recommended that generalized seedings take place prior to the second chaining operation so as to get adequate soil coverage of the seed (Cain, 1971; Plummer, et.al. 1968). The more expensive, less available browse seed may require hand spreading or the use of a device such as a seed dribbler mounted above the track of a crawler tractor. It is imperative that the best available information regarding seeding considerations and recommendations be consulted prior to seeding operations. Two excellent sources are "Restoring Big Game Range in Utah", by A. Perry Plummer and associates, and "The Ely Chain", by Don Cain.

2. Domestic Livestock

Artificial seeding of chained areas is a commonly used practice due to the lack of an available seed source of native forage species on the site at the time of chaining. Successful establishment of the artificial, or introduced, seed will yield a much more rapid increase in grazing capacity than will reliance upon native forage seed source. Various forage species are

artificially seeded at the time of chaining. Selection of the species will depend primarily upon the average precipitation of the particular treatment site. Primary introduced species are listed in Appendix 2.

3. Aesthetics

Artificial seeding will help reduce the short term visual impact by establishing a quick cover over the exposed soil. This practice can be particularly effective when used in combination with piling and burning or removal of dead and down material.

E. Different Chain Link Weights

1. Non-Living Components

The heavier the chain link, the higher the percentage kill and the more surface disturbance. As the percent kill and surface disturbance increase, the runoff decreases and the infiltration rate increases because more trees are uprooted and more pits and furrows are left in the disturbed area.

2. Living Components

a. Plants

Chain link weight will necessarily be influenced by the objectives and conditions of the individual project. If the primary objective is to remove as many trees as possible regardless of their age and there are no overriding considerations, link weight of 70 to 110 pounds have been shown more effective. However, if young trees are to be left for cover or if important understory shrubs are present, the lighter weight link chains are advisable (Cain, 1971; Plummer, 1968).

b. Animals

Experience has shown that heavier chain link weights yield a greater percentage kill of pinyon and juniper with a corresponding increase in the production of forage species. Also, the addition of a length of railroad railing to each link of chain aids in the percentage kill of pinyon and juniper with a corresponding increase in forage production (Cain, 1971).

c. Humans

Basically the lighter the chain link weight, the less impact on woodland products. However, the harvesting of salvage cordwood could be adversely affected by a light anchor chain which would merely push over and partially kill the larger of matured trees.

3. Aesthetics

A heavier chain link weight would probably make little difference in the visual impact. A lighter chain would produce less tree kill and leave spotty pattern when viewed from a distance, but the bent over damaged trees would add to the disarray and unhealthy connotation in the close-up view.

F. Hand Removal of Dead and Down Material

1. Non-Living Components

The more down and dead material removed from the disturbed area, the less surface cover; thus there will be more runoff, more soil erosion and less moisture retained on site.

2. Living Components

a. Plants

Adverse effect on establishment of grasses and forbs due to hotter, drier site resulting from reduction of shade due to removal of debris.

b. Animals

Removal of this cover is adverse to wildlife.

c. Humans

Much of the dead and down material removed could be used for fuel wood, a benefit. No further damage would occur to the remaining trees and shrubs as in the case of burning.

3. Aesthetics

Complete removal of the debris would be the most effective method of reducing visual impact in a chaining project. Overall effect would be similar to piling and burning, but recovery would be quicker, and left-over debris would be less.

G. Designing Layout of Chained Area to Resemble Natural Openings

1. Non-Living Components

If soil type is considered in the design, adverse effects on fragile and/or light soils can be minimized by limiting disturbance to areas of heavier, less fragile soils. Avoiding south and west facing slopes will eliminate the most detrimental drying effects of solar radiation. Eliminating portions of the area from treatment, where slopes exceed 20%, will significantly reduce the danger of heavy runoff and sedimentation.

2. Living Components

a. Plants

This measure would have a beneficial effect on all plants on the area insofar as the design succeeded in avoiding harsh micro-climates of steep south and west facing slopes and low-productivity soils.

b. Animals

All wildlife, especially game species such as deer and elk, will benefit from proper design of the chaining project. Forest openings and edge effect, which can be designed into a chaining project, are invaluable to wildlife.

3. Ecological Interrelationships

The closer the man made openings come to equating openings brought about through natural phenomenoms, the less the ecological interrelationships will change, and the more acceptable the action will become in an ecological sense.

4. Aesthetics

A chained area which reflects the size and shape of natural openings has much less impact when viewed from a distance than one which does not. This would be particularly true of aerial observation. The close-up adverse impact of ground observation would not be changed by this measure.

5. Human Interest Values

Archeological sites could be protected from physical damage during the chaining operation if the design of the area incorporates these sites into the unchained areas. If the design is handled well, the sites would not only be protected from physical damage, they would also not have attention called to them which would invite vandalism and pothunting.

Appendix II

Principle Plant Species Seeded in Pinyon-Juniper Woodland Conversions

Grasses:

Scientific Name	Common Name
Agropyron cristatum	Crested wheatgrass
Agropyron intermedium	Intermediate wheatgrass
Bromus inermis	Smooth brome
Agropyron spicatum	Bearded bluebunch wheatgrass
Dactylis glomerata	Orchard grass

Forbs:

Scientific Name	Common Name
Medicago sativa	Alfalfa
Sanguisorba minor	Small burnet
Astragalus falcatus	Chickpea milkvetch

Shrubs:

Scientific Name	Common Name
Purshia tridentata	Antelope bitterbrush
Cowania stansburiana	Stansbury cliffrose
Atriplex canescens	Fourwing saltbush
Cercocarpus ledifolius	Curlleaf mountain mahogany
Cercocarpus montanus montanus	True mountain mahogany

V. Adverse Effects Which Cannot Be Avoided

A. Non-Living Components

When the vegetative tree cover is removed, the surface will be exposed until the re-establishment of other ground cover. The mitigating measure, artificial seeding, will lessen this adverse impact by shortening the time span required to re-establish the cover.

B. Living Components

1. Plants

Large and medium sized trees will be destroyed representing up to several hundred years of growth. Overall effect on other plants will be negative until the next growing season when removal of the competition for nutrients and water will become effective to effect the mechanical damage suffered during the chaining treatment.

2. Animals

In light of the potential benefits to be derived from properly designed chaining of closing or closed stands of pinyon-juniper, adverse effects on wildlife are relatively insignificant.

Certainly, the impact during the operation on those animals in the subject area must be severe. Most of the animals involved however, exhibit considerable resiliancy and accommodation to such environmental disturbance and the direct adverse effects of the chaining can be expected to be short term. This, of course, depends on the overall project design and the considerations given to wildlife. The possibility exists that some adverse

effects may take place but are not detectable due to lack of detection sophistication, the lack of life data on some animals, or the indirectness of the consequences.

Deferment of grazing by livestock will be necessary for a period of two to five years while forage plants establish, gain vigor and produce seed. The area treated will produce no harvestable forage for livestock during this period.

3. Humans

The harvesting of fence posts and pinyon nuts on the treated area will be eliminated.

C. Ecological Interrelationships

These interrelationships will certainly be altered, but proper design of the project will minimize the impact of such alteration.

D. Aesthetics

The adverse impacts of the proposed action will vary with location, size and shape of the project as well as the mitigating measures that can be undertaken. The proposed action without mitigating measures creates a substantial impact on the close-up view. With the mitigating measures even the close-up impact can be substantially reduced. In some cases it may be possible to end up with a net gain in the quality of the visual environment. With careful preplanning of the size and shape and location of the project area and complete cleanup of the debris, either through piling and burning or removal, most of the adverse impacts on the visual environment can be negated. Even in the close-up view, given a few years for rehabilitation, a project area can be almost devoid of any negative impact.

Regardless of how carefully a chaining project is designed or what methods are used, it will never quite look like a natural situation. In all cases there is a tremendous adverse impact on the visual environment during the clearing process and until vegetative cover is re-established.

E. Human Interest Values

Removal of the trees will result in the loss of shade for recreation users. There will also be a psychological impact on the recreation user who is an environmental purist, in that any evidence of man's tampering with the natural environment will be objectionable to such an individual.

Educational and scientific value which could be gained from study of the mature woodland trees will be destroyed. Also, the cultural practice of gathering pine nuts by certain Indian tribes, will be eliminated on the treated sites.

VI. Relationship Between Short-Term and Long-Term Productivity

A. Short-Term Productivity

1. Non-Living Components

The soil will be exposed to water and wind erosion by the removal of the tree canopy. Surface runoff will be increased. Much of this detrimental effect is reduced by leaving the debris in place. The mitigating measure of artificial seeding will re-establish the ground cover, but this will take two or more years.

2. Living Components

a. Plants

Most trees will be destroyed. Grasses, forbs, and shrubs will be damaged, but reduced competition for water and nutrients will usually offset this damage in one or two growing seasons. Generally speaking, annuals show the most obvious immediate response, followed by short-lived half shrubs and perennial grasses. New shrubs may start to become established within a year or two following chaining (Arnold and Schroeder, 1955; Minnich, 1969).

b. Animals

The development of the faunal complex will necessarily be strongly influenced by the vegetational development and those animals utilizing forbs and grasses will likely be the first on the scene.

Forage production continues to increase thru the first two or three years. However, due to the need to defer grazing while forage plants establish, gain vigor and produce seed, no forage will be available for livestock production for a period of two to five years.

c. Humans

A sharp increase in material suitable for fuel wood cutting occurs in the years immediately following treatment. Christmas tree production is reduced for about five years. Fence post and pine nut production is eliminated in both the short and long term for about 100 years.

3. Ecological Interrelationships

The treatment process drastically alters these interrelationships during the short term.

4. Aesthetics

Regardless of what mitigating methods are used, there will be a drastic change in the character of the landscape. Even though a project may be carefully planned and properly laid out, there will be a severe negative impact created during the clearing process and until vegetative cover is re-established on the area. Complete clearing and immediate planting to restore some type of ground cover can help reduce the time period necessary for re-establishment of vegetative cover. Once this cover is established, most of the negative short term impacts will be eliminated.

5. Human Interest Values

With proper mitigating measures, archeologic and historic values will not be adversely affected, but cultural values relating to use of pine nuts will be destroyed for both the short and long term.

B. Long Term Productivity

1. Non-Living Components

Once the vegetative ground cover is re-established, the watershed will stabilize resulting in less runoff, less soil erosion, an increase in infiltration rates and an increased available soil

moisture from the conditions existing prior to treatment.

2. Living Components

Assuming some degree of care has been taken in site selection, a substantial long term increase in vegetational and wildlife productivity can be expected. The potential for these increases has been well documented (Aro, 1971; Arnold and Schroeder, 1955; Cain, 1971; Christensen et.al., 1966; Minnich, 1969; Plummer et.al., 1968) and through proper management, can be of significant benefit to a wide variety of wildlife virtually indefinitely.

Trees (Under 10 feet in height) are not normally damaged by chaining. These trees grow two or three times as fast after release from dominant trees through chaining. Production of forage continues to increase for a period of five to 10 years. (Arnold et.al. 1964) As a result of the increasing competition from young trees, forage production decreases as they continue to grow (Aro, 1971) The woodland type will probably re-establish itself within 100 years if no subsequent treatments are carried out.

3. Ecological Interrelationships

These interrelationships tend to re-stabilize with the establishment of a new plant cover on the site. If seeding after chaining results in an introduced species mono-culture, long term vulnerability to insects and disease can be expected. Establishment of a mixed stand of native grasses, shrubs and forbs should produce a stable ecosystem in replacement of the pinyon-juniper woodland type.

4. Aesthetics

For all practical purposes, the changes to the visual environment caused by a chaining project would be permanent. The trees will probably re-establish themselves eventually, but it would be a long time before the effects of the project were entirely erased. Whether this long-term impact is negative depends upon how well the project was laid out and executed. Close inspection would reveal, for many years, that the entire surface of the ground had been disturbed by mechanical means. The disturbance would be evident by broken rocks, rocks with lichens turned upside-down, etc. not to mention stumps, branches, and other pieces of juniper that would take many, many years to decompose in dry climates, even caterpillar tracks would remain on the ground surface for ten or more years.

5. Human Interest Values

Cultural values relating to use of pine nuts by Indian cultures would be eliminated or greatly reduced for up to 100 years on the treated site.

VII. Irreversible and Irretrievable Commitments

A. Non-Living Components

If other vegetative cover is established following pinyon-juniper removal, there will be no adverse commitments related to soil and water. If a ground cover is not re-established, there will be irreversible and irretrievable commitments which will result in increased runoff, sediment yields and loss of the soils A horizon. There will also be reduced infiltration, soil moisture and permeability.

Wind velocities will be increased with removal of the tree canopy. This will mean that exposed soils will be more susceptible to wind erosion and particulate matter in the air will increase.

B. Living Components

1. Plants

Under normal conditions, no irreversible commitments will be made since the tree cover will usually re-establish itself over a period of some 100 years. However, treatments to marginal sites, particularly during low rainfall cycles, can result in an area devoid of vegetation.

2. Animals

Wildlife and livestock would be affected according to the success in establishing vegetation following treatment. Also, some small animals would probably be killed during the chaining operation, but unless a rare species is involved, there would be no detectable impact on the species population.

3. Humans

The treatment would not place any irretrievable commitments on any woodland community. Irreversible would be in regards to the wasted woodland resource which was unavailable for salvage, or not salvaged. Irreversible may also be the complete dedication of high-quality woodland sites to other uses.

C. Ecological Interrelationships

The normal vegetative succession processes would normally be available to reverse the chaining action over a 100 year period. However, as pointed out under non-living and living components, the action on some sites may result in a barren area.

D. Aesthetics

The changes to the visual environment would be essentially permanent. Tree re-establishment over a long time period and/or artificial seeding and planting could be used to reverse the action on all but the most severe sites (on which no action should be taken anyway).

E. Human Interest Values

Any archeologic or historic value damaged or destroyed during chaining are lost forever.

VIII. Alternatives to Proposed Action

A. No Action

1. Non-Living Components

The alternative of no action will not have any effect on overland flow or sediment production unless the protective cover is lessened or bare ground is increased. As discussed previously, the lowering of protective ground cover will result in larger overland flows and perhaps more frequent flows. Increasing bare ground will cause more sediment production because of raindrop impacting and splashing loose the fines and organic matter, which in turn lowers the nitrogen content of at least the surface soils. (Craddock and Pearse, 1959.)

There is a definite possibility, in some areas, the no action alternative could cause a larger amount of non-wettable soils and thereby increasing overland flow and sediment production.

2. Living Components

Closed canopy stands produce very little forage. This will not change appreciably if no action is taken. In pinyon-juniper stands which are closing and in vegetative types where pinyon-juniper is invading forage production will continue to decrease. (Leopold 1924, Cottam and Stewart 1940, Jameson 1962, Johnson 1962, Arnold et.al. 1964, Blackburn and Tueller 1970, Aro 1971). Elimination of pinyon-juniper control as a management tool can only serve to continue the decline in habitat potential of this vegetational type.

Christmas tree production will be reduced as the stand becomes more mature and the tree canopy closes.

3. Aesthetics

Although a no-action alternative would leave the visual environment in a natural condition, it is conceivable that this could result in a negative impact. There are areas where a continuous canopy of pinyon-juniper might create a monotonous tunnel effect along a heavily traveled highway. In this type situation, it could be advantageous to create cleared areas directly adjacent to the highway for the purpose of relieving the monotony or for opening up scenic vistas to distant points of interest.

B. Burning

1. Description of the Proposal

The use of fire to control pinyon-juniper stands has been used in a few areas. The availability of research findings is limited. Fire has been used in various ways in treating P-J stands. Three major types of burning treatments have been undertaken:

a. The broadcast burning of mature tree stands.

b. The burning of individual trees where neither the trees nor the understory plants are dense enough to carry fire.

c. The burning of grasslands to kill small invading trees.

When fire is employed as a tool to control small invading trees, seeding may or may not be used as a mitigating measure. Where there is sufficient understory to not leave barren voids in the protective watershed cover, seeding would probably not be used, but where significant voids in protective watershed cover seeding would be considered as a combination practice.

With either broadcast burning or individual tree burning where the understory is not dense enough to carry a fire, a combination of seeding in the ash is generally used.

2. Environmental Impact of the Proposed Action

a. Non-Living Components

(1) Soil and Water

The impact of burning generally tends to decrease the infiltration rate of the soils directly under the fire. The hotter the fire gets and the duration it burns, dictates the effect on the soil infiltration rate. The density or area affected by fire will have a definite influence on the amount of runoff from a given site.

Studies in Oregon on slash burning (Austin 1955) have shown that immediately after a burn, the water holding ability of the soils was reduced 33% and that a 75% loss of organic matter and 67% of the total nitrogen had been experienced. The available quantities of the major nutrient elements--phosphorous, calcium and magnesium--had increased eightfold due to the burn. The pH had risen from a 4.5 preceeding the burn to a 7.6 or alkaline condition after the burn.

In Arizona, Fuller et.al (1955) found the most prominent changes brought about by fire were caused by the destruction of the surface layer of duff and unincorporated organic matter. Soluble salts derived from the ash of the duff leached into the soil causing an increase in the pH, available phosphorous, exchangeable bases and total soluble salts and a decrease in organic matter and C/N ratio to a depth of 8 to 12 inches. They found burning of the duff resulted in a greater dispersion of the surface few inches of soil and greater compaction than was found on unburned soils. Infiltration

rate was reduced on burned areas. The microbiological activity of the soil decreased slightly in direct relationship with the extent of the burning of the duff layer and organic matter.

Ulamis (1955) found that on prescribed burns in second growth ponderosa pine, a heavy burn resulted in an increase in soil nitrogen over either a light burn or the unburned control plot. There was also a marked increase in phosphate due to the burns.

Microbial soil properties show a definite change following slash burning. Wright and Torrant (1957) showed where light burns were applied there were no bacteria or actinomycite populations, but severe burns resulted in an increase in the number of the microorganisms. Fungal populations did not recover from the burn as quickly as bacteria. Both light and severe burns reduced their number. However, the burn apparently stimulated a number of common soil microorganisms such as Gleodadium spp.

Macroscopic and microscopic pore volume as well as percolation rate apparently are affected by burns in young ponderosa pine (Tarrant, 1956). Both percolation rate and macroscopic pore volume were increased after burning while the microscopic volume was decreased. Total pore volume or bulk density showed no change. He concluded that very light burns probably burned out root cavities yet not the duff cover. The soil did not get hot enough to change colors.

(2) Air

Although the full impact of prescribed burns on the air quality are not known, it appears one burn would not be generally harmful to air quality where proper burning conditions exist. However, as the number of fires increase, the effect on air quality could become detrimental.

Prescribed burns may be responsible for reduced visibility and dangerous traffic situations when the proper conditions for good smoke dispersal are not present during the burn. When burning under a strong temperature inversion, the smoke dispersal is normally lateral and held below the inversion level. This could cause the hazardous conditions for highway travelers, etc. When burning under a strong lapsed condition, there will be a near vertical smoke volume produced which could cause safety hazards for air travel if the burning happens to fall within heavily used air corridors of airliners. Precautions can be taken to avert these conditions unless the burn requires extended burning periods. In this case, weather predictions may not be accurate enough to insure good smoke dispersals and burning only what will be consumed in a short period of time should be considered.

The principle products of full combustion of woody plants are: carbon dioxide, water vapor, and carbon monoxide, and certain hydrocarbons. Most of what is actually seen in a smoke column is water vapor. Oxidation processes in the upper atmosphere, which receives shortwave ultraviolet radiation from the sun, convert carbon

monoxide to the dioxides with time (stern, 1968).

Smoke particles act as condensation nuclei that initiate precipitation. Cramer (1969) has pointed out that particulates are washed out or fall out as a result of wind and gravity.

b. Living Components

(1) Plants

Jameson (1962) reported fire killed 70-100% of the juniper tree less than four feet in height while only 30-40% of those trees taller than four feet were killed in a broadcast burn. The exception to these general statements were, when trees 8-10 feet tall had combustible material such as tumbleweeds under the tree and the fire traveled in the same direction as the prevailing winds, then 60-90% of these trees were killed. Where this condition does not exist, less than 10% of the trees 8-10 feet tall were killed.

(2) Animals

(a) Wildlife

Anything that disturbs or destroys a climax vegetational condition favors invasion by subclimax plants (Dasmann, 1971). Fire, chaining, herbicidal treatments and other pinyon-juniper control techniques all basically accomplish the same end in creating a subclimax condition. As the overwhelming majority of wildlife species are dependent to a greater or lesser degree on a subclimax situation, the value of judicious control of pinyon-juniper is obvious. Fires have often been responsible for creating the mixed vegetation necessary for optimum levels of wildlife in many areas of the pinyon-juniper zone. Burned area shrubs are commonly unusually rich in protein and phosphorus as well as being more palatable and digestible (Einarsen, 1946; Hanson & Smith, 1970; Lay, 1957; Swank, 1956).

The effects of fire certainly are not always beneficial. Antelope bitterbrush, serviceberry, big sage and the partially shrubby weeds can be badly damaged by fire and require a prolonged period of careful management for recovery (Blaisdell, 1953; Pechanec, 1954). Fire can and often does destroy valuable forage cover and other habitat components as well as wildlife itself.

Where vegetational characteristics and other resource values permit, a satisfactorily controlled burn may be the most economical method of creating habitat diversity in closing or closed stands of pinyon-juniper. Fire, though a potential management tool, still cannot be critically controlled with reliability. The risk is invariably present that all the prior planning, precautionary measures and good intentions may go up in smoke.

(b) Domestic Livestock

Prescribed burns on past BLM projects and natural burns without artificial seeding have yielded sufficient forage to support an average of an animal unit month on 12 surface acres, as compared to 36 acres on untreated sites.

(3) Humans

A broadcast burn would eliminate Christmas tree products from the site. Post materials could be salvaged after burning providing the fire was not so hot as to consume the medium sized trees. The pine nut resource would be destroyed if the burning was successful in killing the mature trees.

Dead and down trees found on the site would probably be consumed by any burning effort, destroying their potential for firewood. However, one of the side effects to a hot burn which would destroy the overstory trees could be the creation of a readily available firewood source, from the balance of the stand.

c. Aesthetics

(1) Ground Observation. Using burning as a method of pinyon-juniper removal would have much the same effect on ground observation of the visual environment as chaining. The major difference would be the standing dead trees remaining instead of the stacks of debris. The initial revegetation would be much quicker than with chaining because there is little or no disturbance of the soil. Although there would be less remaining debris, decomposition would take much longer because the dead trees remain standing instead of in contact with the ground.

(2) Aerial Observation. Depending upon the control measures use, burning would probably have much less impact on the aerial observer than chaining. Burned areas tend to take on natural shapes and look more like a part of the natural landscape. Because there is less remaining debris and little or no surface disturbance, the area is less obvious to both aerial and distant ground observers.

d. Human Interest Values

Unidentified historic sites and articles would be affected to the extent that any historic remains such as wooden antiques, old bottles or glassware, etc. would be affected by fire. Burning would destroy any wooden or fiberous archeological artifacts within the burned area.

3. Mitigating Measures

a. Proper Burning Conditions

The effects of fire on soils and the watershed can be lessened by selecting burning conditions which will allow the fire to consume the combustible material rapidly with minimal increase in temperatures of the soils. Optimum conditions are generally present a few days following precipitation, and are characterized by low atmospheric temperatures, low relative humidity, and high soil moisture. When these conditions are present, some of the litter may not be consumed by the fire thereby also lessening the adverse effect on the watershed protective cover.

b. Artificial Seeding

(1) Non-Living Components

The amount and kind of protective cover which replaces the tree canopy cover following burning has a large effect on overland flow and sediment production. In most heavy stands of P-J, the understory perennial vegetation would have large openings since very little perennials exist directly under the trees; therefore, it would alleviate some of the long range impact on watershed if the area is seeded immediately following the burn.

In most areas, pinyon and juniper grow in a climatic zone where two definite precipitation patterns and periods exist. There normally is a fall-winter precipitation period, which is received in the form of snow and favors an early spring growth period for cool season grasses and shrubs. The other period of precipitation usually is in the summer and early fall in the form of thunderstorms. This precipitation period favors warm season grasses. Therefore,

the species planted should coincide with the most dependable precipitation period of the area. Establishment of ground cover through artificial seeding will greatly reduce the exposed soil areas subject to soil loss through water or wind erosion.

(2) Living Components

(a) Plants

Artificial seeding will enhance the re-establishment of a plant cover on the site. The species composition of the artificial seeding will generally take a predominate position in the newly established plant community, and if properly selected will provide a beneficial ground cover and forage potential. Artificial seeding should not have any impacts on the growth and development of the residual woodland community. Dense stands of grass however, may have an adverse impact on re-establishment by tree seedlings.

(b) Animals

There are relatively few closing and closed stands of pinyon-juniper in which artificial seeding may not be required. In determining the necessity of seeding, Plummer (et.al. 1968) indicates that at least one desirable shrub and 10 desirable herbs per 100 square feet should be present if satisfactory improvement is to be realized without seeding. Generally, however, seeding is required if optimal forage composition and production is to be realized. It is recommended that generalized seedings take place in the ashes soon after the fire is out. The more expensive, less available

browse seed may require hand spreading. It is imperative that the best available information regarding seeding considerations and recommendations be consulted prior to seeding operations. Successful establishment of the artificial, or introduced, seed will yield a much more rapid increase in grazing capacity than will reliance upon native forage seed source. Various forage species are artificially seeded after burning. Results of seeding, without mechanical covering, are highly variable.

(3) Aesthetics

Artificial seeding will help reduce the short term visual impact by establishing a quick cover over the exposed soil.

c. Falling Standing Dead Trees

It is doubtful any overwhelming wildlife benefit would be obtained by either leaving the trees standing or knocking them over. Exceptions would be the value of standing trees as perches, particularly for raptors or cover enhancement should the trees be felled and piled.

Standing dead trees may have value as aesthetic snags for photography or collection by recreation users. Falling the dead trees would help reduce the visual impact to some degree but would not really be effective unless the downed material could be removed from the site.

4. Adverse Effects Which Cannot be avoided

a. Non-Living Components

The adverse effects caused by burning on watershed and soils can be partially mitigated by selection of proper burning conditions. However, where the temperatures under concentrations of woody

material reach extremes, the lowering of infiltration rates, altering of the available chemical constituents, and lowering of the permeability rate of the surface 0-2 inches will still occur. The degree to which this happens of course depends on the amount of debris and the meteorological conditions present during the burn.

The adverse effects which cannot be avoided on air quality would be the smoke emission. Gaseous and particulate matter will be present and cannot be avoided.

The air quality following the burn will depend upon the ground cover obtained. Dust particulate matter will increase if good protective ground cover is not obtained.

b. Living Components

Fire can and often does kill wildlife and, depending on location, can destroy valuable forage, cover and other habitat components. The lye leaching from ashes of larger fires can kill entire fish populations (Davis, 1959). Browse species dependent on seed for reproduction can be virtually eliminated if two successive fires occur within 5-10 years (Wright, 1972). Bitterbrush and the partially shrubby weeds are badly damaged by fire and require a prolonged period of careful management for recovery (Pechanec, 1954). Harvestable forage due to burning will be lost the year of the burn. Deferment of grazing will be necessary while forage plants establish, gain vigor and produce seed. The combination of these two will result in no forage harvest for a period of from two to five years.

c. Aesthetics

As with chaining, the degree of adverse impact will vary with the size and location of the project. The unavoidable visual impact would be the debris and bare soil during the period of revegation. A complete cleanup of the area would be desirable and would eliminate most of the adverse impacts.

5. Relationships between Short-Term and Long-Term Productivity

a. Non-Living components

The short time productivity of the watershed will be adversely affected due to the removal of protective cover and the effects of fire on the soils. Whether these are considered long term or short term effects depends on the amount of perennial ground cover obtained within the treatment area. The ground cover obtained is dependent, to a large extent, on the temperatures created by the fire in the 0-2 inch soil layer. As a rule, those areas which get hot enough to change the soil color will be affected for more than five years. Those soils which do not change color will overcome the loss of productivity in less than five years.

b. Living Components

(1) Plants

Short term productivity will depend in part on the extent and severity of the burn. A large hot burn on an area with relatively little understory may sufficiently eliminate immediate seed sources as to cause considerable time lag in revegetation over that when other control methods are used. Artificial seeding can shorten

the time element, particularly if seeding is accomplished shortly after the burn (Plummer, et.al. 1968). Getting soil coverage of the seed is also an advantage.

(2) Animals

As with chaining, annuals generally are first to establish followed by perennials and shrubs. The diversity and productivity of wildlife will generally correspond to the diversity and productivity of invading vegetation.

Long term wildlife productivity from the burn will depend on follow-up management of the area. Many accidental burns have proven invaluable to wildlife for a considerable number of years. Harvestable forage for livestock will be lost for a period of two to five years.

As opposed to chaining, pinyon and juniper show little tendency to return to burned areas; therefore, forage production does not appear to decrease over time as it does with other practices.

(3) Humans

If burned trees were left standing, there would over a long period of time be the possibility of collecting weathered specimens for rock gardens and special landscaping effects. During the interim fireplace wood would also be available, and if trees were left standing they would, in the long run, be better quality for fireplace burning.

Other woodland products such as pine nuts, posts and Christmas trees would be unavailable for periods ranging to 100 years or more.

c. Aesthetics

The short term impact on the visual environment would be quite severe, particularly to the closeup viewers. Immediate cleanup of dead material and artificial seeding would help reduce the length of time those impacts would be a problem. The long-term impact would depend on location and how well the project is laid out and executed. If it were done properly, the only impact would be that of change from trees to grass and shrubs. This would not necessarily be a negative impact.

6. Irreversible and Irretrievable Commitments

a. Non-Living Components

The burning process will remove much of the existing protective material covering soils and watersheds. This, in most cases, will be covered with herbaceous plants or a new stand of trees; however, if some natural phenomena prevent new protective cover from becoming established, the watershed would be left unprotected and increased sediment and overland flow would result.

b. Living Components

If natural phenomena prevent a sub-climax grass-shrub type from becoming established, or the re-establishment of the climax pinyon juniper type, the resulting barren landscape would not produce either plants, animals, or products for humans.

c. Aesthetics

Once the trees are dead, the effects are irreversible as far as the visual environment is concerned. Because of the slow growth rate, it would be many years before the area would restore itself to the original condition. In some areas it may never return to the same condition.

C. Chemical Control

1. Description of the Action

Robinson and Cross (1969) and Scifres (1972) have shown that pelleted picloram (4-amino-3,5,6-trichloropicolinic acid, potassium salt) is effective in the treatment of redberry juniper (juniperus pinchoti, Sudw.). Jameson and Johnsen (1964) have also reported that stump treatment with PBA (Polychloro Benzoic Acid) and soil applied pelleted finuron (1,1-dimethyl-3-phenylurea) are promising chemicals for use of sprout prevention on alligator juniper (Juniperus dippeana Stued.).

E. I. duPont de Nemours Company no longer pellet fenuron so this chemical cannot be considered any further. The use of PBA as a stump treatment would only be used in combination of some other primary treatment such as chaining so it will not be considered. Since Dicamba (3,6-dichloro-o-anisic acid) is only one-third to one-half as effective as is picloram, we will only look into the environmental impact of picloram. At the present time, picloram is not registered for general use on range lands.

2. Environmental Impact of Proposed Action

a. Non-Living Components

Studies to determine the fate of picloram applied to soils have shown that not all the chemical could be accounted for and that further studies to determine its fate in soils are needed (Bovey, Dowler and Merkle, 1969). In heavy application, some of the chemical can move from the treatment area. Norris (1969) has reported that where 67 percent of a watershed was sprayed in August, residues up to 78 ppb were detected after the initial one-inch rainstorm and decreased

thereafter. No residues were found after late October or where only a small portion of the watershed was treated. Green (1970) has reported that after applications of 1, 2 and 4 pounds active ingredient per acre, runoff water contained 0.1, 0.5 and more than 0.5 ppm of picloram, and after 15 inches of rain, residues had dropped to 0.01, 0.03 and 0.03 ppm, respectively.

Haas et al., (1971) has shown that the residue content in runoff water was affected by the length of time between application and the first runoff of producing storm. If runoff occurred within two weeks, picloram residues were as high as 184 ppb while if six weeks lapsed before runoff occurred, the picloram content was 28 ppb. These findings agree with various studies cited by Bovey and Scifres (1971).

Haas et al. (1971) also reported they could find no picloram contamination in well water up to two years after the adjacent area was treated with one pound active ingredient per acre. They also reported that picloram concentrations in pond water decreased rapidly after 100 days down to a relatively stable concentration of 5 ppb. These data indicate that picloram could be used safely in an enclosed drainage basin of relatively small size but the use of the chemical in areas where runoff waters will enter live streams would be questionable.

The decomposition of picloram in soil is dependent on several soil characteristics and meterological characteristics--increasing rainfall, higher temperatures and increasing ultra violet light tend to decompose or leach the chemical more rapidly than cooler

temperatures, lower precipitation rates and decreasing amounts of ultraviolet light.

Soil organic matter content, PH, microbal populations and infiltration rates of the soil all influence the decomposition rate of picloram.

Hamaker, et al., (1967) have reported their estimate of the half-order constant (K ½) for picloram to vary from 0.2 in colder, drier areas to 1.0 in hotter, wetter areas. At a two pound per acre rate of application in the colder, drier areas, it would take 4.6 years to decompose the material to the 0.01 oz. per acre concentration, while in the hotter, wetter area, only 11 months would be required to accomplish this degree of decomposition. Merkle, et al., (1967) found the effectiveness of picloram was reduced if extended periods of hot, dry, sunny weather followed application. Hall, et al. (1968) found that ultraviolet light caused a 20 percent decomposition of picloram for each 48 hours of exposure. Merkle, et al. (1967) found that ultraviolet light photo decomposition in petri dishes greatly exceeded that rate which occurred in the field.

Results from some studies suggest a strong correlation between soil organic matter content and decomposition of picloram. Other studies indicate the maximum rate of decomposition is related to the activity of the microbial population which, in turn, is related to the organic matter content.

Grover (1968) has shown that soil absorption of picloram increases decreasing PH and increasing organic matter. Hamaker, et al. (1966) have reported that minimum soil absorption occurs in

neutral or alkaline sandy soils low in organic matter. Bovey and Scrifres (1971) in a literature review have said that most investigations have shown picloram was least persistent in sandy soils low in organic matter. Bovey and Scrifres (1971) in a literature review have said that most investigations have shown picloram was least persistent in sandy soils and that soil Ph and percent clay content did not affect the decomposition rate while percent organic matter and moisture content and temperature were important factors. They also reported little was known about microbial breakdown of picloram and suggested the lack of microbial breakdown could account for its persistence. Youngson, et al (1967) studied 19 micro-organisms and found they only decomposed less than two percent of the picloram and that picloram was not a preferred energy source by any of the test micro-organisms as is the case of several phenoxy compounds.

b. Living Components

(1) Plants

All vegetation would be killed in the immediate vicinity of the pellet placement, since the chemical acts as a soil sterilant.

(2) Animals

Picloram has been shown to be relatively harmless to dogs, rats, mice, various species of fish, quail, and ducks, among others, when used as recommended. The applicator should be quite safe in using the material when good safety precautions are used as is recommended with the handling of any herbicide.

McCollister and Leng (1969) could find no adverse effect in albino rats fed picloram at various levels in the diet up to 3,000 ppm through three generations in terms of fertility, gestation, viability and lactation by body weight records and by teratological examination of fetuses. Mice fed 0.01 percent picloram in their diets for four days before mating and 14 days after mating produced the same number of offspring before and after the test.

Kenega (1969) reported on the effects of picloram on 15 species of fish including rainbow trout and channel catfish. He reported formulation of acids, salts, and esters were generally low in toxicity to fish (LC_{50} is greater than 1.0 ppm) and that ester would be the most toxic while the salt form would be the least toxic. If the recommended use directions are followed, there is low potential hazard, if any, to fish from terrestrial runoff water or from direct accidental contamination of water and there is no hazard to birds. Bobwhite quail and mallard ducks had a calculated LC_{50} dosage of 23,000 and 385,000 ppm, respectively. Japanese quail were fed up to 1,000 ppm of picloram in their diets for each of three successive generations without effect on mortality, egg production or fertility.

Hardy (1966) reported on the effect of potassium salt of picloram on the biological food chain of algae-daphnia-fish. The presence of one ppm of picloram did not retard algae growth; the daphnia maintained in the solution for 10 weeks developed and reproduced normally with no buildup in their tissues. Guppies kept in water

at 1 ppm a.e. of picloram and fed a diet of daphnia reared in a similar picloram solution appeared normal in development, behavior and reproduction.

There should be very little possibility of toxicity to any domestic animal from the normal application rate of pelletted picloram. The acute oral toxicity of picloram on various animals is given in various publications. They are: LD_{50} 2,000 mg/kg of body weight in mice and rabbits' 8,200 mg/kg in rats, cattle the LD_{50} is 750 mg/kg and sheep it is 1,000 mg/kg, and chicks is 600 mg/kg. In long-term feedings, albino rats and beagle dogs were fed picloram at a rate of 15 to 150 mg/kg of body weight for two years. No observable adverse effects were noted in either species. No adverse effects were found in sheep or cattle fed picloram at 73 mg/kg/day for 30 days. Palmer and Radeleff (1969) noted that assuming a given amount of forage yield, forage consumption and that all chemical dosage possible would be 7 mg/kg for each pound per acre of herbicide applied, therefore, the maximum dosage that cattle might ingest if fed on vegetation immediately after spraying four pounds per acre of picloram would be 28 mg/kg. McCollester and Leng (1969) calculated the acceptable intake of picloram for man to be 1.5 mg/kg employing a 100 fold safety margin. A person would consume only 0.1 mg per day from meat of animals grazed continuously on grasses containing 200 to 400 ppm picloram. This is only a fraction of the 90 mg/day that a 130 pound man could safely consume and it represents a safety margin of 90,000 to 1 compared to the no ill effect level demonstrated in laboratory animals.

(3) Humans

The dead trees would increase the use for firewood greatly, however, the trees would remain standing, which may tend to discourage people from cutting them for wood. If harvested soon after the leaves fall, the post per hour cut rate would probably be increased which might actually encourage post cutting within the area. Seedling trees more suitable for Christmas trees would be minimal.

c. Aesthetics

The area would resemble a severe tree kill due to abnormal freezing. The larger dead trees would probably remain for 15 years or longer depending on many factors such as wind, ice, and tree size. This may be displeasing to some individuals while others would probably have no objections, since it would resemble a natural phenomenum.

It would not be necessary to fall the standing dead trees unless it affected the aesthetics of the area. If a decision to fall the dead trees is made, they should be placed in areas where active erosion is taking place or burned. If they are burned, the environmental effect would be the same as shown under "Burning as an Alternative Treatment".

d. Human Interest Values

This type of treatment will have no adverse effects on historic or archeologic values. Those cultural practices of the native Indian tribes relating to pine nuts would be adversely impacted in relation to the number of pine nut bearing trees killed.

3. Mitigating Measures

a. Artificial Seeding

Since the cost of the chemicals and the labor for treatment would be highly correlated with the density of pinyon-juniper trees, probably only thin scattered stands of P-J trees could be treated in this manner. Because of this, native vegetation could be expected to be released and there would be no need for artificial seeding. Since the soil around each tree treated, would be sterile for up to five years, artificial seeding would not be practical, anyway.

b. Falling Standing Dead Trees

An occasional tree left standing would be of some value to raptors and, depending on the area configuration, patches of standing trees may provide some escape cover for deer. Falling the trees would reduce the inhibiting effects of shading on some plants and would provide additional cover for small birds and mammals should the trees be piled. Falling the dead trees would help reduce the visual impact to some degree but would not really be effective unless the downed material could be removed from the site. The standing dead trees would be beneficial to photography and collection of gnarled, scenic trees and to the cutting of fuel wood.

4. Adverse Effects Which Cannot Be Avoided

The movement of the herbicide from the immediate treatment area could not totally be avoided. Therefore, the possible effects of the material contaminating streams should be considered when

selecting an area for chemical treatment. There is also the potential for losing valuable understory plants which are located near the treated trees.

Aesthetic impacts will vary with the size, shape and location of the project. Most can be reduced or eliminated by careful planning and execution. However, the dead trees that are left on the site either standing or felled will have a negative impact on the ground observer for many years.

5. Relationship Between Short-term and Long-Term Productivity

a. Short-Term

The chemical will, in all probability, move from the original placement area which will probably increase the harvest of Christmas trees after a period of 15 to 20 years. Immediately following the chemical treatment, there probably would be no Christmas trees.

Recreation activities would probably be lessened overall while some types of recreation uses may increase. Many people like to collect old twisted gnarled tree parts for decorations which would probably be enhanced with chemical treatments. Since very little ground disturbance would occur, increased rockhounding could also occur until other perennial vegetation covered the ground.

Since pelletted picloram is a soil sterilant when applied at heavy rates, the total vegetation will be killed in the immediate area of the pellets. This would probably not be a significant amount of area. The effect would probably be alleviated within five years,

depending on the amount of rainfall received following the treatment.

The likelihood of finding a detectable amount of picloram in a stream one year after treatment is very small, depending, of course, on many variables already mentioned. The chemical will be detectable in soils for a relative short span of time, probably less than five years. Some chemical can be found in the vegetation for approximately two years after treatment, however, according to many toxological tests, it would not be a lethal amount.

b. Long-Term

There would be no long-term effects to either the soil nor water due to the treatment. Because of open nature of the site on which this treatment could be used, a change in sediment production or overland flow would probably not occur.

The only effect on either wildlife or domestic livestock would be an increase in forage and maybe some vegetative species change. The removal of trees would have an adverse effect on bird nesting if the treatment area is large.

6. Irreversible and Irretrievable Commitments

The affect of the chemical on the soil would last less than five years. An intense rainstorm soon after application could cause concentration of the chemical in natural water catchments, which would prolong its effects considerably on those localized areas. Effects of this type of occurrence on the surface water would be negligible because of the diluting effect of the large amount of runoff resulting from an intense storm.

As far as aesthetics are concerned, once the trees are dead, the effects are irreversible as far as the visual environment is concerned. Because of the slow growth rate, it would be many years before the area would restore itself to the original condition. In some areas it may never return to the same condition.

D. Hand Cutting

1. Environmental Impact of Proposed Action

a. Non-Living Components

Hand cutting of individual trees would have a minimal effect on soil disturbance, therefore, the impact on soil properties should not be significant.

The effect on watershed would be from the loss of tree canopy cover; the actual impact of the change in living cover would depend on the handling of the debris. If it is left in place, the effect may not be significant.

Infiltration rates should be affected but very little following this type treatment because the surface soil disturbance would be very minute.

Available soil moisture would probably increase until a new equilibrium is reached with other perennial herbaceous cover and at that time would probably show very little change. Most research work indicates its soil moisture is increased, which allows for greater production of other vegetation but is usually used up by that increased vegetation.

Removal of the tree canopy would result in increased wind velocities on the site, but since little or no soil disturbance would result from this treatment, increases in particulate matter in the air would be minimal.

b. Living Components

(1) Plants

Native vegetation, other than the trees being felled, would not be disturbed by this treatment. This vegetation would therefore, show immediate benefits from the release caused by removal of competition for available soil moisture and nutrients.

(2) Animals

Hand cutting of pinyon-juniper has several advantages over other methods of control: (1) Hand chopping is much more thorough than cabling or dozing because small trees that often escape heavy equipment are removed along with the large trees; (2) hand chopping does not disturb the forage cover so much as uprooting equipment; and (3) hand labor can be used where ranges are too rough for heavy equipment (Arnold and Schroeder, 1955). There certainly are not the risks involved as with other treatments.

Due to the high costs involved with hand labor, it is doubtful this control method can be justified from an economic standpoint for any extensive clearing or closing of closed stands of dense pinyon-juniper. This method is more adaptable to ridding relatively limited areas of smaller invading trees (Arnold and Schroeder, 1955, Arnold et.al., 1964; Cotner, 1963; Miller, 1971). Hand cutting can be very effective in maintaining a seral, sub-climax condition which is of primary value to wildlife. Results of this action for livestock

forage would be similar to double chaining.

(3) Humans

Fence post and fuel wood material can be salvaged during treatment. Christmas tree and pine nut production would be eliminated.

c. Aesthetics

(1) Ground observation. Hand cutting would probably be the most effective method for protecting the visual environment. With this type of removal, careful control could be maintained on the size, shape, and edge effect of the project. Because there would be no surface disturbance, the impact would be the dead material remaining on the ground.

(2) Aerial Observation. With careful control of the size, shape, and location, the visual impact on the aerial observer could be almost non-existent. This, of course, would depend somewhat on the amount of dead material remaining on the ground.

d. Human Interest Values

Properly supervised hand cutting would result in no disturbance to archeological sites or historic values. Cultural aspects of native use of pine nuts would, however, be adversely affected.

2. Mitigating Measures

a. Artificial Seeding

(1) Non-Living Components

There would be a chance to minimize the effect of less living cover if the cut material is placed in small drainage patterns to serve as sediment traps and energy dissipaters to slow overland flow. Artificial seeding would be difficult to accomplish, because a seed bed of disturbed soil will not be present following hand cutting.

(2) Living Components

If the existing perennial understory is not expected to produce the maximum protective ground cover for the site, artificial reseeding should be used to help mitigate the loss of tree canopy cover. Successful establishment of the introduced seed will largely depend upon coverage of the seed. (Plummer et. al. 1960, Cain 1971). Methods used to accomplish seed planting with this treatment would be extremely expensive.

(3) Aesthetics

Artificial seeding will help reduce the short term visual impact by establishing a quick cover over the exposed soil. This practice can be particularly effective when used in combination with piling and burning or removal of dead and down material.

b. Piling and Burning

(1) Non-Living Components

Water and Soils. The effect of burning on both watershed and soils have already been discussed under the alternative of burning. The effects would be the same, again depending on the amount of debris burned and the temperature which the soils reach.

(2) Living Components

Downed trees can provide valuable escape cover for many species of wildlife, particularly when snow is on the ground. Depending on the size of trees and the tree density involved, piling may be advisable to provide better distribution of cover. Each situation will have to be evaluated on its own merits so far as piling and burning are concerned. The Kundaeli and Reynolds (1972) study

indicates that the use of cleared areas by the cottontail rabbit can be maximized by retaining some combination of 70-90 down, dead trees and living shrubs per acre. Piling and burning would eliminate the post and fuel wood forest products, unless they were salvaged during the cutting or piling phases of the operation.

(3) Aesthetics

Piling and burning would be a particularly effective mitigating measure for a project that is hand cut. This would remove the major adverse impact on visual environment.

c. Removing Dead and Down Material

(1) Non-Living Components

Several studies have shown that litter is just as effective as living cover for watershed protection, and therefore would have an adverse effect on watershed and soils if it were removed. The possibility of more destructive runoff water and increased sediment production would be increased unless there was sufficient other perennial vegetation understory to yield the same degree of protective cover.

(2) Living Components

Downed trees can provide valuable escape cover for many species of wildlife, particularly when snow is on the ground. The Kundaeli and Reynolds (1972) study indicates that the use of cleared areas by the cottontail rabbit can be maximized by retaining some combination of 70-90 down, dead trees and living shrubs per acre. This measure would assure the maximum salvage of woodland products, i.e. posts and fuel wood.

(3) Aesthetics

Complete removal of dead and down material on a carefully planned, hand cut project could reduce the adverse impact on the visual environment to almost nothing. The only problem would be during the operation and the short period until vegetation is re-established on the area.

3. Adverse Effects Which Cannot be Avoided

a. Non-Living Components

The possible adverse effect would be that of changing the micro-environment close to the soil surface. There would be a possibility of increased dust particulate in the atmosphere if there is not sufficient cover remaining on the site. This could change the soil to some extent since generally the fines are what becomes airborn and move large distances.

b. Living Components

If the downed material is left on the ground, the only adverse impact to wildlife would be removal of raptor nesting habitat. The harvesting of woodland products would be curtailed for many years.

c. Aesthetics

With careful preplanning and the use of hand cutting, the major adverse impacts to the visual environment would be the remaining dead and down material and the exposed bare soil. By using piling and burning or removal of the dead and down material along with artificial seeding, the negative impacts could be totally eliminated. In some areas, the net result could be an improved aesthetic environment regardless of observer position.

4. Relationship Between Short Term and Long Term Productivity

a. Non-Living Components

The short term effect on soils and watershed generally lasts until the tree canopy cover is replaced by other perennial vegetation understory. There seems to be no long term effect on either watershed or soils where the vegetative cover obtained yields sufficient watershed protection.

b. Living Components

Since handcutting is more suitable for clearing small, scattered trees that are just beginning to invade, and for maintaining cleared areas against reinvasion (Arnold et al. (1964), substantial increases in wildlife probably will not occur. On a short term basis, a sub-climax area with a scattered invasion of pinyon and juniper may actually be of more benefit to wildlife than if the trees were removed. The long term effect of preventing the re-establishment of a full pinyon-juniper overstory would, however, be beneficial to wildlife. Forage production for domestic livestick will continue to increase through the first two or three years. Maximum forage production will probably be obtained between 5 and 10 years. Competition from pinyon-juniper should not materially increase for several additional years. Forage production could be expected to remain high. The harvesting of woodland products would be eliminated for many years with Christmas tree production returning first in about 20 years and other products in 100 years or more.

c. Aesthetics

Hand cutting and use of the mitigating measures previously discussed would reduce both the short and long term impacts to the minimum. The short term impacts would be in effect for the minimum time possible and the long term impacts would be non-existent or would be of a beneficial nature.

5. Irreversible and Irretrievable Commitments

The loss of tree canopy will be lost for an extended period, but in all likelihood, will be retrieved through seedling production eventually. The effects of removal of pinyon-juniper canopy are irreversible as far as the visual environment is concerned. Because of the slow growth rate, it would be a long time before an area could restore itself to the original condition. In some areas, it may never return to the same condition.

E. Tree Crusher

1. Environmental Impact of Proposed Action

a. Non-Living Components

The impact of the tree crusher can only be given from personal observations since no research literature on the subject could be found. The effect on overland flow and sediment production should be much more dramatic than that of a chain. The machine weighs 80 tons approximately. It moves about with electric motors in each of three rollers. The roller wheels are seven feet in diameter with 10-inch cutter blades at 2-foot intervals. A 27 foot push bar with toothed comb front is effective in pushing or pulling out of the ground or breaking off at the root crown most trees

of 2 inch diameter or larger. Branches and small trunks are reduced to short lengths by the roller blades. The machine will handle tree stands of any density. The cutter blades penetrate the soils approximately five inches, depending on the type soil and the amount of obstructions. The depressions made by the cutter blades substantially reduce the overland flow for a time period of 1 to 2 years, depending on several factors such as rainfall intensity, slope gradient, and soil texture. These depressions begin to disappear and fill in normally after the second year but probably reduce overland flow and sediment for a period of approximately five years. The protective groundcover produced by live standing trees is converted to non-decomposing litter which is as effective as standing cover for reducing overland flow and sediment production.

Capillary and non-capillary pore space and bulk densities of soils should show a significant change since the cutting edges when coming out of the ground tend to fluff the soils behind the machine. The machine is not designed to operate on stony soils; therefore, only the more highly productive soils should be considered for manipulation with the tree crusher. The effect of the tree crusher on available soil moisture is not known; however, it is believed the increased infiltration rate following the treatment would offset any increased evaporation rate.

Some adverse impact on air quality would be caused by winds blowing the fluffed bare soil. However, the decomposed litter is spread rather evenly in this operation, and would tend to protect the soil surface, and reduce particulate matter below that which could be expected from a chaining operation.

b. Living Components

(1) Plants

It appears the tree crusher accomplishes about the same percentage of tree kill as does a chaining treatment. In some cases it appears a smaller type tree is left alive than with chaining. That is, it appears that some of the larger trees which bend from the chain would be cut with the tree crusher; those non-sprouting species of juniper of this size class could be killed.

The machine doesn't appear to reduce the perennial grass stand to any significant degree when soil moisture conditions are adequate for the knife edge of the cutter blades to penetrate the soil, but yet where the soil is dry enough not to become compacted between the cutting blades. Organic material piles are broken up but not moved to any great degree. The tree crusher evidently has little long term effects on sprouting shrub understories and may actually rejuvenate decadent stands of these shrubs. Grass species are apparently little affected by the machine. The crushed litter and grouser tracks create an excellent seed bed.

(2) Animals

This treatment is beneficial to livestock if native grasses and shrubs are present, to be released by the tree crushing operation. It must be recognized from the outset that eradicating pinyon-juniper does not automatically equal wildlife habitat improvement. Not every pinyon-juniper stand has the potential to produce significant additional wildlife benefits due to poor soils, low precipitation or other limiting factors. Careful evaluations must be made before any site is selected for control and objectives must be clearly identified. Once a site is selected, the control work has to be judiciously designed and implemented if optimal wildlife values are to be realized. Subsequent wildlife and livestock management of the control area is also of paramount importance if long-term wildlife benefits are to be obtained.

Ranges low in productivity often consist of one or two dominant vegetative species, i.e., big sage, pinyon-juniper, etc. Such monotypic ranges provide poor habitat conditions because a variety of plant species are not produced to meet needs of a diversity of uses (Cain, 1972). Essentially, pinyon-juniper control can be used to prevent or disrupt a monotypic situation and maintain or promote the reestablishment of a subclimax vegetational condition. The early and intermediate successionary plant communities are accepted as being the most beneficial to wildlife (Dasmann, 1971; Leopold, 1933; Leopold, 1950; Lyon, 1966; Woodbury, 1954; and others). Native ranges containing a wide choice of grass, forbs and browse usually support the most abundant wildlife populations (Yoakum, 1971). Properly designed eradication of dense pinyon-juniper

stands on carefully selected sites can be of significant value to many species of wildlife. If management objectives are directed toward creating a grass/forb/shrub complex with recognition given to the proximity of cover, most habitat requirements of a wide variety of animals will be met.

As increased stratification and variance in vegetation is realized, the insect population can be expected to expand followed with an increase in insect eating birds and mammals. Depending on the particular site involved, the food supply for many reptiles and amphibians may also be enhanced. Animals which utilize the roots, stems, leaves, and/or seeds of the plants can be expected to increase. Nesting sites for a considerable number of birds and small mammals will also be increased. The above animals will in turn attract a variety of predatory mammals, birds and reptiles. The establishing shrubs, grass and forbs provide escape cover for these prey species.

Most of the estimated 1,192,000 deer on public domain lands in the west (BLM, 1971) winter in the pinyon-juniper zone. Many thousands of acres of prime winter range have been and are being lost to urban expansion, water development, highways and other human related activities. Widespread overuse of ranges by livestock and game animals (Klemmedson, 1967; Lea, 1969) and increasing densities of pinyon-juniper have also taken their toll.

Converting dense stands of pinyon-juniper to a mixed grass/forb/ browse type will help alleviate some of the problems of declining winter ranges by providing more abundant and diverse forage. Forage

diversity is of considerable importance in the diet of mule deer (Dasmann, 1970; Dietz, 1957; Hill, 1956). Deer certainly are not the only large mammals which may be affected and are only used as an example here. Bighorn sheep (Ovis spp.), antelope or some other species may be of concern reinforcing the necessity of gearing the objectives of any control work to accommodate the animals of that particular area.

Considerable more benefit will be realized from treatment if adequate cover for escape from predators and the elements is retained. Lack of sufficient cover, its sparseness or poor distribution can be significant in limiting or precluding wildlife use of any given potential habitat area (Yoakum and Dasmann, 1969). Different species have different cover requirements and each species needs several different kinds of cover. What suffices as cover during the natal period may be wholly inadequate during the rigors of winter (Nagel, 1956). The moderating effect woody cover has on wind velocity and temperature can be of considerable importance, particularly during the winter (Loveless, 1967). Trees also effectively dampen sound to levels tolerable by wildlife in areas where noise from highways and other sources may be potentially influential in habitat usage (Cook et al., 1971, A. Lorin Ward, 1972). Cover can take many forms and may range from a complex stratification of vegetation to no more than a particular exposure. As most hunters have experienced, topographical irregularities are used extensively as escape cover by many species. Topographical variances and/or downed trees in the control area may often meet the escape cover needs of mule deer.

In areas where these two items may be deficient, an Arizona study indicates that most deer use of clearings occurred within 600 feet of forest cover with decreasing use out to 1200 feet (Reynolds, 1966). This is in close agreement with the recommendation by Minnich (1969) that any point within the chained area not be more than 1/8 mile from undisturbed forest. Undisturbed forest may be fingers or patches of standing trees within the control area as well as the main control border. A recent study indicates that treated area use by another important game animal, the cottontail rabbit, can be increased by retaining some combination of 70-90 down, dead trees and living shrubs per acre (Kundaeli and Reynolds, 1972).

Tree crushing undoubtedly imposes considerable stress on those animals in and immediate to the control area during the chaining operation. Some residual adverse effect on some species may be incurred but the great percentage of animals accommodate such environmental disturbance to a remarkable degree and the detrimental effects of the chaining can be expected to be short term. Project design should provide for the exclusion from control of specific topographic areas which, for one reason or another, wildlife show a particular preference for or are frequented by any rare or endangered species. Certainly, live streams, marshes or other aquatic habitat should not be treated.

(3) Humans

Woodland products such as fence posts, firewood, pine nuts and Christmas trees will be eliminated as a result of this treatment.

c. Aesthetics

(1) Ground Observation

The tree crusher would probably have much the same effect on the ground observer as chaining. The dead and dying material left in place would create an extremely unhealthy connotation and the result would be a definite negative impact.

(2) Aerial observation.

As with the other methods of control, the effects on aerial observation would depend more on the size, shape and location than any other factors. If these items are properly controlled, the adverse effects would be minimal.

d. Human Interest Values

The mechanical action of this piece of heavy machinery would destroy any archeological values on treated areas and would have a detrimental effect on man-made historic features. Indian cultural heritage associated with the use of pine nuts would be eliminated on the treatment site.

2. Mitigating Measures

a. Artificial Seeding

(1) Non-Living Components

Where sufficient native grasses and shrubs are not present to establish protective ground cover following treatment, artificial seeding should be used to provide protection for the soil mantle.

(2) Living Components

Site characteristics will necessarily dictate the desirability of artificial seeding. Should seeding be advisable to obtain better plant composition and density, the recommendations of Plummer (1968) and Cain (1971) should be followed. Electric broadcast seeders are

generally attached to the crusher to accomplish seeding and control in one operation.

Deferment from livestock grazing should be practiced until the seedlings become established following any artificial seedings. The U.S. Forest Service reports that lands producing about 100 pounds of forage prior to treatment have produced in excess of 1000 pounds per acre after tree crushing and seeding.

(3) Aesthetics.

Artificial seeding alone would have little effect on the visual impact caused by the tree crusher. If used in combination with piling and burning, it could be a very effective aid in re-establishing an aesthetically pleasing vegetative cover on the exposed soil.

b. Piling and Burning

(1) Non-Living Components

This practice coupled with tree crushing would defeat the purpose of employing the tree crusher and would be detrimental to soils, watershed and air quality values as discussed under the alternative of burning.

(2) Living Components

Evidence available indicates litter is crushed to the point where piling and burning would be superfluous.

(3) Aesthetics

Piling and burning almost entirely eliminates the debris that is left on the ground after a crushing project, and therefore also eliminates most of the impact to the close-up viewer. This practice has little effect on the overall long range view or on the aerial view. Again, it is the size and shape of the project

which determines the long distance impacts.

3. Adverse Effects which Cannot be Avoided

a. Non-living components

The fact that any surface disturbance will result in a short time removal of watershed protective cover would be minimized by this method. However, the fact remains that some effect on the watershed and soil protective cover will result, which will be detrimental to both water and air quality.

b. Living Components

The biggest potential for adverse effects evidentally lies with the possible destruction of valuable understory shrubs, particularly the non-sprouting varieties, and with the elimination of tree cover within the control area.

Deferment of grazing will be necessary for a period of two or three years while forage plants establish, gain vigor and produce seed. The area treated will produce no harvestable forage for livestock during this period. Harvesting of woodland products will be eliminated on the treated site.

c. Aesthetics.

The adverse impacts of the proposed action will vary with location, size and shape of the project as well as the mitigating measures that can be undertaken. The proposed action without mitigating measures creates a substantial impact on the close-up view. With the mitigating measures, even the close-up impact can be substantially reduced. In some cases, it may be possible to end up with a net gain in the quality of the visual environment. With careful

preplanning of the size and shape and location of the project area and complete cleanup of the debris, either through piling and burning or removal, most of the adverse impacts on the visual environment can be negated. Even in the close-up view, given a few years for rehabilitation, a project area can be almost devoid of any negative impact. Regardless of how carefully a crushing project is designed or what methods are used, it will never quite look like a natural situation. In all cases there is a tremendous adverse impact on the visual environment during the clearing process and until vegetative cover is re-established.

d. Human Interest Values

Proper identification and protection of archeologic and historic sites through layout of the treatment area should mitigate most of the adverse impacts on these values. However, with a machine of this size, some inadvertent damage is bound to occur.

The Indian cultural values of pine nut harvesting and use will, of course, be eliminated along with the mature pinyon pine trees.

4. Relationship Between Short Term and Long Term Productivity

a. Non-Living Components

As a general rule, any mechanical soil disturbing treatment results in a decreased productivity until perennial herbaceous vegetation becomes established, which is usually within the same year of treatment. Then the protective cover would produce a peak of protection until the "plowing" effect of the treatment wore off and a new equilibrium of infiltration rate is reached. Production of the watershed will then decline until the production and available soil moisture reach a steady equilibrium. There would probably be no long term effect produced unless no replacement perennial vegetative cover is established.

b. Living Components

Short term vegetational productivity should generally parallel the pattern obtained with double chaining. Due to the apparently superior seed bed created, gross productivity may be somewhat accelerated over other control methods on a given site. Shrub destruction, though perhaps temporary, may initially limit use by browsing animals. Medium and large animal use may also be somewhat restricted due to the virtual elimination of cover within the control area. The eventual long-term wildlife productivity of tree crusher control areas should be far superior to the dense pinyon-juniper type. Deferment of livestock grazing will be necessary for a period of two or three years while forage plants establish, gain vigor and produce seed. Forage production will probably be maintained for a longer period of time than with double chaining. This practice appears to leave fewer young pinyon and juniper trees. Competition from the trees remaining would not be as critical to forage production. Production of all forms of woodland products would be eliminated for a long period of time (up to 100 years).

c. Aesthetics

Regardless of what mitigating methods are used, there will be a drastic change in the character of the landscape. Even though a project may be carefully planned and properly laid out, there will be a severe negative impact created during the clearing process and until vegetative cover is re-established on the area. Complete clearing and immediate planting to restore some type of ground cover can help to reduce the time period necessary for re-establishment of vegetative cover. Once this cover is established, most of the negative short term impacts will be eliminated. For all practical

purposes, the changes to the visual environment caused by a tree crushing project will be permanent. The trees may eventually re-establish themselves, but it would be a long time before the effects of the project were entirely erased. Whether this long-term impact is negative depends upon how well the project is laid out and executed.

5. Irreversible and Irretrievable Commitments

a. Non-living Components

As long as a substitute perennial vegetative cover is estabilished there are no irreversible impacts on the soil mantle or the related air and water quality.

b. Living Components

The action would remove the pinyon-juniper trees from the landscape for 25 to 50 years, or until seedlings were allowed to become established and retake the site. Unless rare and/or endangered species are involved, no truly irreversible or irretrievable commitments can be identified for wildlife.

c. Aesthetics

The effects of removal of the pinyon-juniper canopy are irreversible as far as the visual environment is concerned. Because of the slow growth rate, it would be a long time before an area could restore itself to the original condition. In some areas it may never return to the same condition.

d. Human Interest Values

Any historic or archeologic sites destroyed during treatment are irretrievable.

F. Pushing

1. Environmental Impact of Proposed Action

a. Non-Living Components

Pushing is a control method that is generally used in stands of pinyon-juniper containing 100 to 250 trees per acre. The tractor used has a movable blade attached to the front and in most cases a push bar is mounted ahead of the blade. The push bar bends the tree forward so the blade can get to the root crown and uproot the tree. This practice is especially useful if there are desirable shrubs in the stand.

Pushing causes less surface disturbance than any of the mechanical methods used to remove the trees. This would be an advantage to the watershed when a good ground cover of shrubs and grasses are present. The runoff and soil erosion is only slightly affected by this method when there is a good understory. There would be little or no effect on the air quality from this mechanical treatment.

b. Living Components

(1) Plants and Animals

The impact of this action is about the same as hand cutting. More young trees would be left with this practice than with hand cutting (Cotner, 1963). Re-invasion of pinyon and juniper would occur at a faster rate than with hand cutting. The result would be a more rapid reduction in forage production. Pushing trees over accomplishes basically the same objective as other control measures in creating and maintaining sub-climax conditions. Bulldozing is an efficient

but slower method than chaining or cabling for clearing ranges of juniper and pinyon trees. If relatively small openings are desired in dense pinyon-stands, bulldozing or a similar method may be more efficient than either hand cutting or chaining. This method is of particular value in uprooting individual trees in stands that are too open for mass treatments such as chaining (Arnold et.al., 1964; Plummer 1968). Net benefits would be similar in many respects to those obtained by chaining or hand cutting.

(2) Humans

Pushing would adversely affect all four of the woodland products. Firewood would be the least impacted since trees would probably season out while lying on the ground and salvage for firewood would be possible. Christmas tree production would probably not be seriously disturbed, because it is not economically feasible to knock down small scattered trees with the blade of a tractor.

c. Aesthetics

(1) Ground observation.

Pushing would have much the same effect on the ground observer as chaining. Since this method is more selective and more thorough than chaining, there would be somewhat less damaged material left standing but the overall effect would be similar.

(2) Aerial Observation

With careful control of size, shape and location, the adverse effects on the aerial observer would be minimal. This, of course, would depend somewhat on the amount of dead material left on the ground.

d. Human Interest Values

The mechanical movement of machinery would likely result in destruction of archeological sites, although the maneuverability of an individual tractor would allow for protection of sites adequately marked prior to treatment. Unidentified and unprotected historic sites could suffer extensively by this method due to movement of mechanical equipment breaking up sparse remnants of on-site history.

2. Mitigating Measures

a. Artificial seeding

(1) Non-Living Components

Artificial seeding will shorten the time of the decreased ground cover. A seed mixture should be used that is adaptable to the area and will provide quick cover and surface protection from water and wind erosion.

(2) Living Components

Site characteristics will necessarily dictate the desirability of artificial seeding. Should seeding be advisable to obtain better plant composition and density, the recommendations of Plummer (1968) and Cain (1971) should be followed. Deferment from livestock grazing should be practiced until the seedlings become established following any artificial seeding.

(3) Aesthetics

Artificial seeding alone would probably have little effect on the visual impact. If used in combination with piling and burning or removing dead and down material, it would be a very effective aid in establishing a vegetative cover on the exposed soil. Scattered

seeding of specific areas to woody plants would help make an area more aesthetically pleasing.

b. Piling and Burning

(1) Non-Living Components

This measure decreases soil infiltration rate which increases runoff and soil erosion, and removes necessary organic matter and nitrogen from the soil. It results in increased topsoil loss through wind and water erosion.

(2) Living Components

The downed trees provide shade to establishing vegetation and cover for wildlife. Removal of the downed material through burning or other means, is generally detrimental to wildlife and neutral with regard to livestock forage. This measure would also eliminate salvage of fuel wood.

(3) Aesthetics

Piling and burning is a very effective method for reducing the adverse visual impact of the proposed action. This would eliminate most of the dead and down material and would, therefore, eliminate the major adverse factor in the close-up view of a project area.

c. Hand Removal of Dead and Down Material

(1) Non-Living Components

The more down and dead material removed from the disturbed area, the less surface cover; thus there will be more runoff, more soil erosion and less moisture retained on site.

(2) Living Components

There is an adverse effect on establishment of grasses and forbs due to the hotter, drier site resulting from removal of shade

producing debris. Removal of this cover is adverse to wildlife. Much of the dead and down material removed could be used for fuel wood, a benefit. No further damage would occur to the remaining trees and shrubs as in the case of burning.

(3) Aesthetics.

Complete removal of the debris would be the most effective method of reducing visual impact in a chaining project. Overall effect would be similar to piling and burning, but recovery would be quicker, and left-over debris would be less.

3. Adverse Effects which Cannot Be Avoided

a. Non-Living Components

The watershed will be subject to increased runoff until ground cover is re-established. This effect will not be as great as when all vegetation has been removed and/or damaged under other mechanical methods of treatment.

b. Living Components

(1) Plants

Large and medium sized trees will be destroyed representing up to several hundred years of growth. Overall effect on other plants will be negative until the next growing season when removal of the competition for nutrients and water will become effective to affect the mechanical damage suffered during the treatment.

(2) Animals

No significant adverse effects on wildlife can be identified if cover considerations are made. Exceptions may be found on a given site, particularly if rare or endangered species are present. Certainly, the impact during the operation on those animals

in the subject area must be severe. Most of the animals involved however, exhibit considerable resiliancy and accommodation to such environmental disturbance and the direct adverse effects of the treatment can be expected to be short term. This, of course, depends on the overall project design and the considerations given to wildlife.

Deferment of grazing by livestock will be necessary for a period of two to five years while forage plants establish, gain vigor and produce seed. The area treated will produce no harvestable forage for livestock during this period.

(3) Humans

The harvesting of fence posts and pinyon nuts on the treated area will be eliminated.

c. Aesthetics

The adverse impacts of the proposed action will vary with location, size and shape of the project as well as the mitigating measures that can be undertaken. The proposed action without mitigating measures creates a substantial impact on the close-up view. With the mitigating measures, even the close-up impact can be substantially reduced. In some cases it may be possible to end up with a net gain in the quality of the visual environment. With careful pre-planning of the size and shape and location of the project area and complete cleanup of the debris, either through piling and burning or removal, most of the adverse impacts on the visual environment can be negated. Even in the close-up view, given a few years for rehabilitation, a project area can be almost devoid of any negative impact.

Regardless of how carefully the project is designed or what methods are used, it will never quite look like a natural situation. In all cases there is a tremendous adverse impact on the visual environment during the clearing process and until vegetative cover is re-established.

d. Human Interest Values

Removal of the trees will result in the loss of shade for recreation users. There will also be a psychological impact on the recreation user who is an environmental purist, in that any evidence of man's tampering with the natural environment will be objectionable to such as individual.

Educational and scientific value which could be gained from study of the mature woodland trees will be destroyed. Also the cultural practice of gathering pine nuts, by certain Indian tribes will be eliminated on the treated sites.

4. Relationship Between Short & Long Term Productivity

a. Non-Living Components

The short term impact will be the increased runoff and soil erosion from the time of the action until ground cover is re-established. Long term productivity will be decreased runoff and greater soil moisture availability.

b. Living Components

(1) Plants

Most trees will be destroyed. Grasses, forbs, and shrubs will be damaged, but reduced competition for water and nutrients will usually offset this damage in one or two growing seasons. Generally speaking, annuals show the most obvious immediate response, followed by short-lived half shrubs and perennial grasses. New shrubs may

start to become established within a year or two following chaining (Arnold and Schroeder, 1955; Minnich, 1969).

(2) Animals

Productivity relationships will necessarily be dependent on the site characteristics involved. If the site is in dense pinyon-juniper, productivity will generally follow the same pattern as with chaining. Unless artificially seeded, annuals will most likely invade the area first followed by perennial grasses and shrubs (Arnold and Schroeder, 1955; Minnich, 1969). Animal productivity will necessarily show a strong correlation with the abundance and diversity of vegetational development. (Refer to Part VI.A.3. and VI.B.3.)

If pushing or bulldozing is used to eliminate scattered trees just beginning to invade, substantial increases in wildlife productivity probably will not occur. On a short term basis, a sub-climax area with scattered invasion of pinyon-juniper may actually be of more benefit to wildlife than if the trees were removed. Clearing the invading trees will help maintain the wildlife productive sub-climax condition for an indefinite time period. Forage production continues to increase thru the first two or three years. However, due to the need to defer grazing while forage plants establish, gain vigor and produce seed, no forage will be available for livestock production for a period of two to five years.

(3) Humans

A sharp increase in material suitable for fuel wood cutting occur in the years immediately following treatment. Christmas tree

production is reduced for about five years. Fence post and pine nut production is eliminated in both the short and long term for about 100 years.

c. Aesthetics

(1) Short Term

Regardless of what mitigating methods are used, there will be a drastic change in the character of the landscape. Even though a project may be carefully planned and properly laid out, there will be a severe negative impact created during the clearing process and until vegetative cover is re-established on the area. Complete clearing and immediate planting to restore some type of ground cover can help to reduce the time period necessary for re-establishment of vegetative cover. Once this cover is established, most of the negative short term impacts will be eliminated.

(2) Long Term

For all practical purposes, the changes to the visual environment caused by treatment will be permanent. The trees may eventually re-establish themselves, but it would be a long time before the effects of the project were entirely erased. Whether this long term impact is negative depends upon how well the project is laid out and executed.

5. Irreversible and Irretrievable Commitments

a. Non-Living Components

If other vegetative cover is established following pinyon-juniper removal, there will be no adverse commitments related to soil and water. If a ground cover is not re-established, there will be irreversible and irretrievable commitments which will result in increased

runoff, sediment yields and loss of the soil's A horizon. There will also be reduced infiltration, soil moisture and permeability.

Wind velocities will be increased with removal of the tree canopy. This will mean that exposed soils will be more susceptible to wind erosion and particulate matter in the air will increase.

b. Living Components

(1) Plants

Under normal conditions, no irreversible commitments will be made since the tree cover will usually re-establish itself over a period of some 100 years. However, treatments to marginal sites, particularly during low rainfall cycles, can result in an area devoid of vegetation.

(2) Animals

Wildlife and livestock would be affected according to the success in establishing vegetation following treatment. Also, some small animals would probably be killed during the chaining operation, but unless a rare species is involved, there would be no detectable impact on the species populations.

(3) Humans

The treatment would not place any irretrievable commitments on any woodland community. Irreversible would be in regards to the wasted woodland resource which was unavailable for salvage, or not salvaged. Irreversible may also be the complete dedication of high-quality woodland sites to other uses.

c. Ecological Interrelationships

The normal vegetative succession processes would normally be available to reverse the effects of the treatment over a 100 year period. However, as pointed out under non-living and living components, the action on some sites may result in a barren area.

d. Aesthetics

The changes to the visual environment would be essentially permanent. Tree re-establishment over a long time period and/or artificial seeding and planting could be used to reverse the action on all but the most severe sites (on which no action should be taken anyway).

e. Human Interest Values

Any archeologic or historic value damaged or destroyed during chaining are lost forever.

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